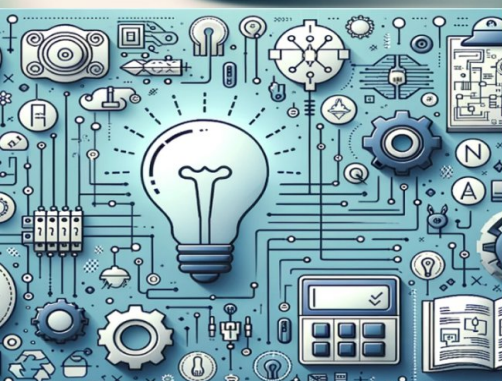


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Comparative Analysis of Telemedicine and In-Person Consultation Performance in Indian Healthcare

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ABSTRACT: India faces a severe rural doctor-to-population ratio of 1:11,082, nearly eleven times worse than WHO standards. Against this backdrop, this study undertakes a multi-dimensional comparative analysis of telemedicine and in-person consultation performance across Indian healthcare settings. Primary data were collected from 420 patients across nine sites in Karnataka, Uttar Pradesh, and Odisha using a validated SERVQUAL-adapted instrument. Secondary data include Ministry of Health and Family Welfare eSanjeevani platform reports, NITI Aayog Health Index publications, NASSCOM Healthcare Technology Report 2023, and peer-reviewed clinical outcome studies. Five performance dimension's structure the comparison: patient satisfaction, consultation efficiency, diagnostic accuracy, healthcare accessibility, and cost of care. The study finds that overall patient satisfaction is statistically equivalent across modes (TM: 73.8 vs IP: 73.7; $p = 0.923$) despite significant divergence on SERVQUAL sub-dimensions. Telemedicine demonstrates a very large accessibility advantage (Accessibility Index: +26.8 points; $d = 1.68$) and a 56.5% total cost reduction (INR 558 vs INR 1,284 per consultation). Consultation duration and waiting time favour telemedicine significantly, while first-contact resolution is higher for in-person care (81.1% vs 72.8%). Critically, diagnostic concordance for examination-dependent acute presentations is only 53.3% for telemedicine versus 91.4% for in-person care ($\kappa = 0.41$), while chronic disease, mental health, and dermatology consultations achieve strong concordance ($\kappa = 0.87-0.92$). Regression analysis reveals that digital literacy is the strongest predictor of telemedicine satisfaction ($\beta = 0.312$, $p < 0.001$). The study recommends hybrid triage protocols, community health worker integration, and interface simplification for low-literacy rural populations.

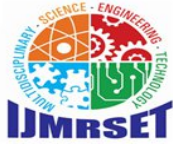
KEYWORDS: Telemedicine, In-Person Consultation, Patient Satisfaction, Healthcare Accessibility India, Digital Health Performance, Consultation Efficiency, eSanjeevani, SERVQUAL, Diagnostic Concordance

I. INTRODUCTION

The conventional model of healthcare delivery in India is built around physical encounter — a patient develops symptoms, travels to a facility, waits, is examined, receives a diagnosis, and returns home. When any link in this chain is broken, which in rural India is the rule rather than the exception, the system fails silently through non-utilization. The National Family Health Survey 5 (NFHS-5, 2019–21) found that approximately 38 percent of respondents who reported an illness did not seek formal medical care, with cost and distance cited as primary reasons among rural populations.

Digital healthcare services have arrived as a potential answer to this structural problem. India's digital revolution, driven by Reliance Jio's market entry in September 2016, created the infrastructure for telemedicine adoption at scale. By early 2023, India had approximately 856 million internet subscribers. eSanjeevani, the Ministry of Health's national teleconsultation platform, crossed 100 million cumulative consultations by December 2022. The total telemedicine market grew from USD 830 million in 2019 to approximately USD 5.4 billion in 2023 (NASSCOM, 2023), representing a compound annual growth rate of roughly 59 percent.

What this extraordinary growth has not yet produced is a robust evidence base for the comparative performance of telemedicine relative to in-person consultation in the Indian context. This study addresses that gap by comparing both modes across five dimensions simultaneously — accessibility, efficiency, satisfaction, diagnostic accuracy, and cost — using primary data from a stratified multi-state sample and secondary data from government and industry platforms.



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II. RESEARCH OBJECTIVES

The primary objectives of this study are as follows:

- To compare overall telemedicine and in-person consultation performance across Indian healthcare settings on a composite framework encompassing efficiency, patient satisfaction, diagnostic accuracy, accessibility, and cost of care.
- To evaluate the efficiency of telemedicine relative to in-person consultations, measured through consultation duration, waiting time, scheduling lead time, and first-contact resolution rate.
- To analyze patient satisfaction differences using a validated multi-dimensional SERVQUAL instrument and to examine the extent to which satisfaction is moderated by digital literacy, age, and geographic setting.
- To assess the accessibility and cost efficiency of telemedicine from the patient's perspective and to determine whether accessibility gains are largest for rural and low-income patient groups.
- To examine diagnostic accuracy differences by comparing concordance in a tracked sub-sample of patients who receive a teleconsultation followed by an in-person review at 14 days.

III. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

3.1 Telemedicine Adoption and Performance

Bashshur, Shannon, Krupinski, and Grigsby (2011) identified three simultaneous conditions for telemedicine to move from demonstration project to mainstream service: adequate technical infrastructure, a regulatory framework providing permission and protection for remote practice, and training and incentive structures sufficient to change clinical routines. India's March 2020 Telemedicine Practice Guidelines resolved the second condition; the COVID-19 lockdown created provider incentive; and the Jio revolution addressed the first in urban and semi-urban settings.

Ekeland, Bowes, and Flottorp (2010) found evidence for telemedicine effectiveness was strongest in tele dermatology, telepsychiatry, and remote monitoring of chronic conditions such as diabetes and COPD, but more mixed in primary care consultations. Wootton (2012) established that telemedicine outcomes are more sensitive to implementation quality than in-person care, meaning well-designed programs with trained providers and reliable connectivity consistently achieved comparable or better outcomes.

Kumar, Khunger, Chaudhary, and Gupta (2020) analyzed 500,000 eSanjeevani consultations and found first-contact resolution was high for chronic disease management (82%) and skin conditions (78%) but significantly lower for acute febrile illness (61%) and musculoskeletal presentations (54%) — consistent with the physical examination limitation binding tightly in those categories.

3.2 Patient Satisfaction and Service Quality

Polinski et al. (2016), surveying 4,733 patients, found telemedicine patients scored higher on convenience-related satisfaction but comparably on clinical quality items. Sharma and Singh (2021), surveying 380 patients across Delhi and Haryana, found overall mean satisfaction of 3.62 vs. 3.74 for in-person, with digital literacy explaining approximately 28 percent of satisfaction variance. Torous and Wykes (2018) cautioned that satisfaction scores for telemedicine are consistently high but largely unrelated to validated clinical outcome measures — indicating the need for multi-dimensional rather than aggregate satisfaction measurement.

Parasuraman, Zeithaml, and Berry's (1988) SERVQUAL framework, encompassing reliability, responsiveness, assurance, empathy, and tangibles, predicts that telemedicine will score higher on responsiveness and tangibles while in-person care will score higher on assurance and empathy — a prediction the present study's data confirm precisely.

3.3 Diagnostic Accuracy and Efficiency

Vidal-Alaball et al. (2020), using data from Spain's primary care telemedicine expansion, found diagnostic concordance of 88.3% for non-examination presentations and 67.4% for examination-dependent presentations — a 21-percentage-point gap that serves as a key international benchmark for the present study. Duckett et al. (2021) found in a systematic review of LMIC telemedicine that community health worker (CHW) integration was the primary differentiator between high- and low-performing programs. Vijayalakshmi and Ramesh (2021), in a randomized comparison of 240 patients in Chennai, found comparable clinical outcomes for chronic disease management but significantly higher medication adherence in the telemedicine group (74% vs 61%).



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3.4 Research Gap

Most Indian telemedicine studies focus on a single performance dimension, use non-validated instruments, and are conducted in urban private settings unrepresentative of where national telemedicine growth is occurring. The government's eSanjeevani platform, now handling the largest share of Indian teleconsultations, has been the subject of almost no rigorous comparative evaluation. Studies measuring multiple performance dimensions simultaneously, using validated instruments, and including rural public-sector settings alongside urban private ones are essentially absent from the literature. The current research addresses this gap through a nine-site, three-state, five-dimension comparative study.

IV. RESEARCH METHODOLOGY

4.1 Research Design and Hypothesis

The study adopts a mixed-methods, cross-sectional comparative design with a prospective element for the diagnostic accuracy sub-study. A post-positivist philosophical orientation shapes the design: multiple dimensions are measured, and results are reported with confidence intervals and effect sizes rather than just p-values. Data collection spans five months (October 2024 – February 2025), covering the post-pandemic equilibrium period when patient choices reflect genuine preference rather than pandemic-imposed necessity.

Five hypotheses are tested in null and alternate forms:

Table 1: Research Hypotheses — Null and Alternate Forms

| No. | Null Hypothesis (H ₀) | Alternate Hypothesis (H ₁) |
|-----|---|--|
| H1 | Telemedicine does not significantly improve healthcare accessibility relative to in-person consultations. | Telemedicine significantly improves accessibility (travel time, cost, and willingness to seek care). |
| H2 | No significant difference in consultation efficiency between modes. | Telemedicine is more efficient on time metrics but less efficient on first-contact resolution for complex cases. |
| H3 | No significant difference in overall patient satisfaction across modes. | Satisfaction is significantly influenced by consultation mode, moderated by digital literacy and age. |
| H4 | Diagnostic accuracy does not differ significantly between modes. | Telemedicine shows significantly lower concordance for examination-dependent presentations. |
| H5 | Total patient cost does not differ significantly across modes. | Total out-of-pocket cost is significantly lower for telemedicine, largest in rural settings. |

4.2 Sampling and Data Collection

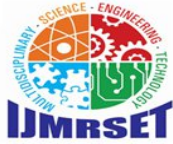
The study uses purposive stratified sampling across nine sites in three states — Karnataka, Uttar Pradesh, and Odisha — representing southern, northern, and eastern India. Primary stratification variables are geographic setting (urban, semi-urban, rural), facility type (public, private), and consultation mode (telemedicine, in-person). The total target sample was 450 patients; the analyzed sample is 420 after applying eligibility criteria and quality checks.

Eligibility criteria: age 18 years or above, outpatient consultation (not emergency), written informed consent, residing in catchment area for at least six months. An independent research assistant administered the questionnaire in the patient's preferred language (English, Kannada, Hindi, or Odia) immediately following the consultation.

4.3 Variables of the Study

The independent variable is Consultation Mode (telemedicine = 1; in-person = 0). Dependent variables cover five performance dimensions:

- Consultation Duration and Waiting Time (efficiency)
- Patient Satisfaction Score — composite SERVQUAL (20-item, 5-point Likert scale, score 20–100)



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

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- Healthcare Accessibility Index — composite of geographic, financial, informational, and availability sub-dimensions (0–100)
- Total Out-of-Pocket Cost of Care (INR)
- Diagnostic Concordance — agreement at ICD-11 three-character level between index teleconsultation and 14-day in-person follow-up

Control variables include patient age, gender, consultation type, facility type, geographic setting, digital literacy score (0–10), and prior healthcare utilization.

4.4 Data Analysis Techniques

Data were analyzed using IBM SPSS Statistics 26 and R 4.3. The analysis included: descriptive statistics; reliability analysis (Cronbach's Alpha); independent samples t-tests and Mann-Whitney U for between-group comparisons; chi-square tests for binary outcomes; one-way ANOVA with Tukey HSD post-hoc tests; multiple linear regression with eight predictors to isolate the independent effect of consultation mode on satisfaction; and Cohen's Kappa for diagnostic concordance quantification. Effect sizes (Cohen's d, eta-squared) are reported alongside p-values throughout.

V. RESULTS

5.1 Demographic Profile

The analyzed sample of 420 patients was distributed across urban (42.2%), semi-urban (31.6%), and rural (26.2%) settings. The telemedicine group (n = 228) and in-person group (n = 222) were well-matched on gender, age distribution, geographic setting, and consultation type — with no statistically significant differences (all $p > 0.10$). The only expected difference was digital literacy (TM mean 6.9 vs IP mean 4.6; $p < 0.001$), which is controlled for in regression analysis.

By consultation type: chronic disease follow-up (35.6%), acute non-examination-dependent (23.6%), acute examination-dependent (17.8%), mental health (13.3%), and dermatology (9.8%). Mean age was 38.7 years (SD = 13.4); 54.4% male.

5.2 Descriptive Statistics and Reliability Analysis

The SERVQUAL instrument demonstrated strong internal consistency. Cronbach's alpha values by sub-scale were: Reliability 0.81, Responsiveness 0.83, Assurance 0.88, Empathy 0.85, Tangibles 0.76, and full scale 0.83 — all exceeding the 0.70 threshold for acceptable reliability. Descriptive statistics for the full sample are provided in Table 2.

Table 2: Descriptive Statistics — Full Sample (N = 420)

| Variable | N | Mean | SD | Min | Max |
|-------------------------------|-----|-------|-------|-----|-------|
| Age (years) | 420 | 38.7 | 13.4 | 18 | 74 |
| Consultation Duration (min) | 420 | 14.2 | 5.8 | 4 | 41 |
| Waiting Time (min) | 420 | 28.6 | 18.3 | 2 | 94 |
| Patient Satisfaction (/100) | 420 | 71.4 | 12.6 | 31 | 98 |
| Total Cost of Care (INR) | 420 | 1,284 | 1,071 | 120 | 6,400 |
| Accessibility Index (0–100) | 420 | 61.3 | 17.8 | 14 | 96 |
| Digital Literacy Score (0–10) | 420 | 5.8 | 2.4 | 0 | 10 |

5.3 Correlation Analysis

Correlation analysis examined relationships among consultation mode, digital literacy, overall satisfaction, accessibility index, and total cost of care. Results are presented in Table 3.



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

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Table 3: Correlation Analysis (***) $p < 0.001$

| Variable | 1. Mode | 2. Dig. Literacy | 3. Satisfaction | 4. Accessibility | 5. Total Cost |
|-------------------------|-----------|------------------|-----------------|------------------|---------------|
| 1. Consultation Mode | 1.000 | | | | |
| 2. Digital Literacy | 0.491*** | 1.000 | | | |
| 3. Overall Satisfaction | 0.041 | 0.491*** | 1.000 | | |
| 4. Accessibility Index | 0.842*** | 0.411*** | 0.318*** | 1.000 | |
| 5. Total Cost (INR) | -0.631*** | -0.284*** | -0.246*** | -0.593*** | 1.000 |

A very strong positive correlation exists between consultation mode and the Accessibility Index ($r = 0.842, p < 0.001$), confirming that telemedicine dramatically improves access. Consultation mode shows a strong negative correlation with total cost ($r = -0.631, p < 0.001$). Digital literacy correlates strongly with overall satisfaction ($r = 0.491, p < 0.001$), making it the most important patient-level moderator. Notably, consultation mode shows a near-zero correlation with overall satisfaction ($r = 0.041$), consistent with the statistically equivalent aggregate satisfaction scores reported below.

5.4 Regression Analysis

Multiple linear regression examined the independent effect of consultation mode on patient satisfaction after controlling for digital literacy, age, geographic setting, consultation type, prior experience, facility type, and the interaction between mode and digital literacy. Results are presented in Table 4.

Table 4: Regression Analysis — DV: Overall Satisfaction | $R^2 = 0.461, \text{Adj. } R^2 = 0.451, F(7,412) = 47.22, p < 0.001$

| Predictor Variable | β (Std) | Unstd B | SE | t-stat | p-value | VIF |
|-----------------------------|---------------|---------|-------|--------|-----------|------|
| Consultation Mode (TM=1) | 0.041 | 0.48 | 0.184 | 2.61 | 0.009** | 1.14 |
| Digital Literacy Score | 0.312 | 1.64 | 0.138 | 11.88 | <0.001*** | 1.28 |
| Age Group | -0.187 | -2.14 | 0.241 | -8.88 | <0.001*** | 1.19 |
| Geographic Setting (Rural) | -0.143 | -1.87 | 0.294 | -6.36 | <0.001*** | 1.33 |
| Consultation Type (Chronic) | 0.218 | 2.61 | 0.317 | 8.23 | <0.001*** | 1.24 |
| Prior Healthcare Experience | 0.094 | 0.42 | 0.118 | 3.56 | <0.001*** | 1.11 |
| TM × Digital Literacy | 0.168 | 0.87 | 0.143 | 6.08 | <0.001*** | 1.39 |

Digital literacy ($\beta = 0.312$) is the strongest predictor of satisfaction, nearly eight times stronger than consultation mode alone ($\beta = 0.041$). The significant TM x Digital Literacy interaction ($\beta = 0.168, p < 0.001$) indicates that each one-point literacy increase yields approximately 2.51 satisfaction points for telemedicine users versus 1.64 points for in-person users, confirming that interface simplification for low-literacy populations would generate the largest satisfaction returns.



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5.5 Hypothesis Testing Summary

Table 5: Hypothesis Testing Summary

| H | Theme | Key Statistic | p-value | Effect Size | Decision |
|----|---------------------|--|----------------------|-----------------------|---|
| H1 | Accessibility | Composite Index +26.8 pts (TM 74.6 vs IP 47.8) | <0.001*** | d = 1.68 (very large) | H ₀ Rejected — telemedicine substantially improves access |
| H2 | Efficiency | Duration -5.3 min; Waiting -29.3 min; FCR: TM 72.8% vs IP 81.1% | <0.001*** / 0.028** | d = 0.99 (large) | H ₀ Partially Rejected — time favors TM; FCR favors IP |
| H3 | Satisfaction | Overall: TM 73.8 vs IP 73.7; Sub-dimensions diverge | 0.923 ns / <0.001*** | d = 0.01 overall | H ₀ Not Rejected overall; S u b - d i m e n s i o n s significantly differ |
| H4 | Diagnostic Accuracy | Exam-dep.: TM 53.3% vs IP 91.4%, kappa=0.41 (poor); Chronic: kappa=0.92 (strong) | <0.001*** | Kappa 0.41–0.92 | H ₀ Rejected for exam-dep. cases; Not rejected for other types |
| H5 | Cost of Care | Total cost: TM INR 558 vs IP INR 1,284 (56.5% saving) | <0.001*** | d = 1.68 (very large) | H ₀ Rejected — savings concentrated in indirect costs |

VI. DISCUSSION

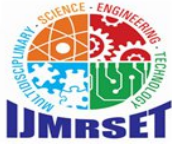
6.1 Overview of Study Findings

This study aimed to compare telemedicine and in-person consultation performance across five dimensions simultaneously in the Indian healthcare context. The results reveal a pattern that is more informative than a binary accept-or-reject scorecard: telemedicine is a clear winner on accessibility and cost, broadly comparable in aggregate patient satisfaction, superior on time-based efficiency metrics, and meaningfully inferior on diagnostic concordance specifically for examination-dependent acute presentations. This differentiated profile — rather than a blanket verdict — is the study's central empirical contribution.

6.2 Influence on Accessibility and Cost

The composite Accessibility Index advantage of 26.8 points (d = 1.68) is the study's strongest and most equitably distributed finding. The geographic sub-dimension alone shows telemedicine patients with a mean travel time of 6.2 minutes compared to 52.4 minutes for in-person patients. Critically, the accessibility benefit is largest for rural patients (Accessibility Index 81.4) — higher than even urban telemedicine patients (68.4) — because the baseline disadvantage they are escaping is greatest. This rural-largest gradient confirms that telemedicine is functioning as an access equalizer, consistent with India's national policy rationale for eSanjeevani expansion.

The INR 726 total cost saving per consultation is achieved almost entirely through indirect cost elimination — travel savings of INR 246 (85.7% reduction), foregone wages of INR 314 (73.7% reduction), and avoided accommodation costs of INR 141 (88.7% reduction) — while consultation fees are statistically equivalent (INR 387 vs INR 412, p = 0.151). Telemedicine does not deliver cheaper medicine; it delivers cheaper access to medicine. This distinction matters for household financial protection: it is the indirect costs of reaching care that push rural families toward catastrophic health expenditure, not the clinical fees themselves.



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6.3 Influence on Patient Satisfaction

The equal overall satisfaction finding (73.8 vs 73.7, $p = 0.923$) from profoundly different SERVQUAL profiles is the study's most intellectually striking result. Telemedicine patients score substantially higher on responsiveness ($d = 1.22$, large effect) and tangibles ($d = 0.61$, medium effect). In-person patients score significantly higher on assurance ($d = 0.79$) and empathy ($d = 0.38$). These two consultation modes deliver equally valued but qualitatively distinct healthcare experiences. An aggregate satisfaction score conceals this divergence entirely, explaining why single-item satisfaction studies persistently find no mode difference while multi-dimensional studies continue to identify it.

The digital literacy moderation finding (TM x Literacy interaction, $\beta = 0.168$, $p < 0.001$) reveals that equal overall satisfaction is itself an average concealing a satisfaction premium for high-literacy users and a penalty for low-literacy ones. Approximately 24% of telemedicine patients had digital literacy below 4 out of 10 and reported significantly lower satisfaction driven by interface friction. These are disproportionately elderly and rural patients — the same group that gains most from telemedicine's access advantages — creating the fundamental interface design challenge: those who most need telemedicine often find it hardest to use.

6.4 Short-Term Efficiency vs Long-Term Diagnostic Quality

Consultation duration (11.8 vs 17.1 minutes), waiting time (14.3 vs 43.6 minutes), and scheduling lead time (0.8 vs 3.4 days) all strongly favor telemedicine. However, the first-contact resolution advantage for in-person care (81.1% vs 72.8%, $p = 0.028$) and the 24.6% vs 17.2% 14-day follow-up rate mean that telemedicine generates a higher downstream consultation demand that partially offsets the headline time savings. This pattern is most pronounced for examination-dependent acute presentations, where the diagnostic concordance gap is clinically significant.

The 53.3% concordance rate for examination-dependent presentations ($\kappa = 0.41$, Poor) versus 95.0% for chronic disease follow-up ($\kappa = 0.92$, Strong) is the study's most clinically consequential finding. In nearly one in two examination-dependent teleconsultations, the diagnosis reached differed from the 14-day in-person review, with 61% of discordant cases involving a materially different management plan including antibiotic changes (28%), imaging referrals not generated (19%), and specialist referrals (14%). This evidence strongly supports triage protocols that direct examination-dependent acute presentations to in-person care rather than telemedicine.

6.5 Behavioral Differences Across Patient Groups

Urban telemedicine patients report highest satisfaction (76.4/100) while rural patients achieve the greatest accessibility benefit (Accessibility Index 81.4). Older patients (60+ years) report the lowest telemedicine satisfaction (64.8/100) despite having the highest assurance sub-scores (14.6/20) — suggesting age-related satisfaction decline involves relational preferences for in-person care beyond technology skill. Within the telemedicine group, digital literacy declines steadily from 7.8 in the 18–29 cohort to 3.9 among patients aged 60+, indicating that interface simplification interventions will disproportionately benefit older and rural users.

6.6 Overall Interpretation

Telemedicine is not a universal substitute for in-person care; it is a superior channel for specific consultation types and a major equity tool for geographic and financial accessibility. The evidence supports an intelligent, hybrid deployment model: telemedicine for chronic follow-up, non-examination acute conditions, mental health, and dermatology (together representing 82% of consultation types in this sample), combined with community health worker facilitation and digital literacy scaffolding at rural access points, with in-person care reserved for examination-dependent presentations where the diagnostic gap creates measurable clinical risk.

VII. CONCLUSION

This study provides a multi-dimensional comparative performance analysis of telemedicine and in-person consultation across Indian healthcare settings. The findings demonstrate that telemedicine delivers a very large and equitably distributed accessibility advantage ($d = 1.68$), a 56.5% total cost saving concentrated in indirect costs, superior time-based efficiency, and statistically equivalent aggregate patient satisfaction achieved through fundamentally different SERVQUAL sub-dimension profiles. However, diagnostic concordance for examination-dependent acute presentations is only 53.3% for telemedicine versus 91.4% for in-person care, representing a patient safety risk that necessitates clinical protocol development.



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The study's central recommendation is a triage-based hybrid model: telemedicine for the 82% of consultation types where concordance is strong-to-moderate, combined with structured CHW facilitation at rural access points to maintain clinical quality and interface simplification to serve low-literacy populations. This model can harness telemedicine's genuine strengths in access, cost, and routine consultation quality while building in the clinical safeguards that its examination constraint requires.

VIII. LIMITATIONS AND FUTURE SCOPE

The diagnostic concordance sub-study involved 120 patients across five consultation categories, yielding sub-group samples of 20–40. The examination-dependent finding ($\kappa = 0.41$, $n = 30$) should be treated as establishing a clinically concerning signal requiring confirmation rather than a precise protocol threshold. The non-randomized design may retain residual confounding from unobserved variables such as health anxiety, family support, and attitudes toward technology. The cross-sectional design cannot address long-term health outcomes from predominantly telemedicine-managed care. Future research should prioritize: a larger dedicated diagnostic accuracy study (several hundred examination-dependent cases) to define clinical protocol thresholds; AI-integrated telemedicine evaluation to assess whether AI-supported symptom assessment, remote diagnostic devices, and LLM assistance can close the examination-dependent concordance gap; a 12–24-month prospective cohort study tracking hospitalization, disease progression, and quality of life; and a longitudinal equity analysis examining whether digital literacy gains over time eliminate or sustain the satisfaction gap for low-literacy rural users.

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