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The Double-Edged Sword of Digital Health: A Mixed-Methods Study on the Efficacy and Health Equity Implications of AI-Powered Telemedicine Platforms in Post-Pandemic Rural Communities.

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ABSTRACT

Artificial intelligence (AI)-supported telemedicine may extend clinical expertise to rural communities, yet its benefits can be offset by unequal connectivity, digital literacy, data representation, and institutional readiness. This study examined the efficacy and health-equity implications of AI-powered telemedicine in post-pandemic rural Indonesia. A qualitative-dominant, convergent mixed-methods secondary study integrated reflexive thematic analysis of peer-reviewed qualitative evidence and Indonesian policy documents with descriptive synthesis of verified national and clinical datasets. Evidence included 2023 national internet statistics, a 63,012-person chronic-disease survey, a 311-patient rheumatology survey, and a 15-interview qualitative study. Telemedicine was most effective for stable follow-up, medication management, specialist access, and travel-cost avoidance, but was less reliable for first diagnosis, unstable disease, and examination-dependent care. Rural internet use (59.33%) remained 17.47 percentage points below urban use (76.80%). Among people with hypertension and/or diabetes, 98.0% reported no telemedicine use, indicating a substantial implementation gap. Four integrated themes emerged: conditional clinical efficacy, redistributed rather than eliminated access burdens, algorithmic amplification of structural disadvantage, and the necessity of human-mediated hybrid care. Conclusion: AI-powered telemedicine is neither inherently equalizing nor intrinsically exclusionary. Its equity effect depends on assisted access, low-bandwidth design, representative validation, clinician oversight, interoperability, and disaggregated monitoring.

Keywords:
Artificial Intelligence, Telemedicine, Digital Health, Rural Health, Health Equity

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1. INTRODUCTION

The COVID-19 pandemic transformed telemedicine from a peripheral service into a central mechanism for preserving access to health-care. In Indonesia, distancing requirements, pressure on facilities, and interruptions in routine care accelerated the use of video consultation, text messaging, hospital portals, and commercial platforms. This acceleration occurred within an archipelagic health system in which geography, uneven specialist distribution, transport costs, and facility capacity had already constrained access. Post-pandemic telemedicine therefore inherited two different identities: an emergency workaround that reduced physical contact and a potential long-term infrastructure for geographically distributed care. Evidence from Indonesian rheumatology illustrates this transition.

In a survey of 311 patients with autoimmune rheumatic diseases, 81 patients, or 26.0%, used telemedicine during the pandemic; among these users, 54.3% preferred telemedicine during the pandemic and 40.7% continued to prefer it for the post-pandemic period [1].

The policy environment also shifted from temporary adoption toward institutionalization. Indonesia's 2023 Health Law distinguishes telehealth as the wider provision and facilitation of clinical, public-health, information, and self-service functions through digital communication, while defining telemedicine as the provision and facilitation of clinical services through those technologies. It requires digitally enabled care to connect with the National Health Information System and obliges system operators and professionals to protect the confidentiality of individual health information.

Minister of Health Regulation No. 20 of 2019 remains in force and specifically governs telemedicine between health-service facilities [2].

SATUSEHAT, meanwhile, functions as the official national health-data exchange platform, with electronic medical-record interoperability mandated through Minister of Health Regulation No. 24 of 2022 and supported by the national digital health transformation framework.

This institutional expansion coincides with a second technological shift: the incorporation of AI into telemedicine. AI-powered platforms can include automated symptom collection, risk stratification, clinical decision support, medical-image interpretation, personalized reminders, conversational agents, and predictive systems that identify patients requiring escalation. In principle, these capabilities can compensate for specialist scarcity, support frontline workers, and make remote encounters more consistent. A systematic review of AI and telemedicine in rural communities identified recurring applications in earlier diagnosis, patient monitoring, real-time decision support, chronic-care management, and specialist consultation [3]

WHO nevertheless cautions that the clinical promise of AI is inseparable from risks involving autonomy, safety, privacy, opacity, accountability, bias, inclusiveness, and sustainability.

The resulting policy problem is not simply whether telemedicine "works." Efficacy is multidimensional. A platform may reduce travel, waiting time, and missed follow-up while still producing inferior information for conditions requiring palpation, auscultation, laboratory testing, or direct observation. It may improve the speed of triage while increasing false reassurance if symptom inputs are incomplete. It may expand nominal coverage while excluding households without affordable devices, stable electricity, sufficient bandwidth, confidence in digital interfaces, or private space for consultation. It may help a clinician process information while transferring clerical work, alerting management, and medico-legal uncertainty to an already burdened workforce. Evaluating digital health therefore requires attention to the interaction among technology, task, patient, clinician, organization, and place.

The same qualification applies to health equity. Equity concerns the fair distribution of opportunities to attain health, not merely equal availability of an application. A service may be technically open to everyone but function unequally because the resources needed to convert access into benefit are stratified. Indonesian data reveal precisely this distinction. The BPS reported that 69.21% of people aged five years and older had accessed the internet in 2023, compared with 76.80% in urban areas and 59.33% in rural areas [4].

Connectivity also varies sharply among provinces; later analysis of BPS data reported rural household internet access of only 18.73% in Papua in 2023, demonstrating that a national mean conceals severe territorial disadvantage.

Thus, digital availability, meaningful use, and effective clinical benefit represent successive thresholds rather than interchangeable outcomes.

Rural disadvantage is also heterogeneous. Older adults, people with low incomes or limited formal education, residents who use local languages, people with disabilities, women without autonomous access to household devices, and patients with complex chronic illnesses may encounter overlapping barriers. These are not reducible to personal reluctance. They reflect infrastructure, affordability, interface design, trust, caregiving arrangements, and power. A national study based on the 2023 Indonesia Health Survey included 63,012 people with hypertension and/or diabetes and found that 98.0% had not used telemedicine. Non-use was more likely outside Java and Bali, where internet access, device availability, and digital capability tend to be weaker [5].

This finding exposes the difference between the visibility of commercial telemedicine in national discourse and its actual penetration among populations with a high need for continuing care.

AI can intensify this difference. Models trained on data concentrated in urban tertiary hospitals may encode patterns that do not represent rural epidemiology, language, care pathways, or data quality. The WHO has warned that systems trained primarily on high-income-country populations may perform poorly in low- and middle-income settings and recommends designs that reflect diverse socioeconomic and health-care contexts.

Even within Indonesia, a model trained using digitally documented, urban, insured, and frequently connected patients may underrepresent people whose records are fragmented, whose consultations occur through community health workers, or whose symptoms are described in non-standard terms. Missingness is therefore not random; the same structural conditions that impede care can render marginalized groups less visible in the datasets used to automate care [6].

At the same time, dismissing AI-enabled telemedicine would ignore real benefits. Recent Indonesian qualitative evidence based on 15 semi-structured interviews conducted in 2024 across six of the country's seven regions found that telemedicine remained valuable after the pandemic for chronic and rare diseases, follow-up, medication

management, and specialist access. Respondents described reduced travel and consultation costs, but clinicians also emphasized poor connectivity, diagnostic limitations, digital-literacy disparities, legal concerns, and burnout.

Rural health-worker literature similarly identifies unstable internet and low digital literacy as practical barriers while recognizing telemedicine as a means of connecting remote services to needed expertise.

Therefore, the central question is not whether digital care should replace physical care, but under what conditions it adds clinical value without widening avoidable differences in access, safety, voice, and outcomes [7].

Existing Indonesian scholarship remains fragmented across adoption studies, disease-specific surveys, legal analysis, platform-readiness research, and pandemic accounts. A 2026 literature review found that the strongest evidence concerns readiness, usability, acceptance, fragmentation, and feasibility, while long-term clinical effectiveness, economic evaluation, cybersecurity governance, and equity-sensitive implementation remain underdeveloped.

A rural and remote Indonesia scoping review similarly found evidence for continuity, reach, information flow, and frontline adaptation, but limited evidence for durable system integration and transformation.

Consequently, implementation success is often inferred from registration, platform launch, or consultation counts rather than demonstrated through clinically appropriate, equity-disaggregated outcomes.

The title's "double-edged sword" captures this conditionality. One edge reduces distance, transaction costs, and specialist scarcity; the other can transform social inequalities into digital exclusion and algorithmic bias. These effects may occur simultaneously. A low-income rural patient who successfully avoids a day of travel may still depend on a family member's phone, disclose sensitive information without privacy, and receive an algorithmically prioritized recommendation that is difficult to question. Conversely, a low-bandwidth, community-mediated service may be less technologically sophisticated yet more equitable because it aligns with local infrastructure and preserves human assistance. Technological intensity and public value should therefore not be treated as synonyms [8].

This study addresses this gap through a qualitative-dominant convergent mixed-methods secondary design focused on post-pandemic rural Indonesia. The approach preserves the user-requested emphasis on comprehensive qualitative analysis while retaining the mixed-methods claim in the title through integration of verified quantitative indicators. It does not present invented interviews, simulated patient records, or hypothetical effect sizes. Instead, it triangulates published qualitative findings, official legal and policy texts, national connectivity statistics, and two empirical patient datasets to develop an equity-sensitive account of efficacy.

This study has four objectives. First, it identifies the clinical and operational circumstances in which AI-supported telemedicine is likely to provide meaningful benefits in rural post-pandemic care. Second, it examines how connectivity, affordability, literacy, geography, data representation, and platform governance shape the distribution of those benefits. Third, it analyzes whether AI removes access barriers or redistributes them from travel and facility scarcity toward digital capability, informational quality, and data risk. Fourth, it proposes an implementation model in which performance is judged not only by average utilization or accuracy but also by subgroup reach, assisted completion, escalation safety, continuity, and avoidable exclusion. The guiding research question is: How does AI-powered telemedicine simultaneously improve service efficacy and reproduce or mitigate health inequity in post-pandemic rural Indonesian communities?

2. METHOD

Study Design

This study used a qualitative-dominant convergent mixed-methods secondary design (QUAL + quan). The qualitative strand was primary and interpreted how efficacy, access, risk, and governance were constructed across empirical studies and policy documents. The quantitative strand supplied verified descriptive indicators that tested the scale and distribution of patterns identified qualitatively. Both strands were analyzed separately and integrated through joint displays and meta-inference. This design reconciles the title's mixed-methods orientation with the requested emphasis on qualitative analysis while avoiding the fabrication of primary participants or outcomes.

The design should be understood as an analytical evidence synthesis rather than a new clinical trial or original community interview study. It assesses real post-pandemic evidence relevant to rural Indonesia but does not claim to estimate a causal treatment effect of a single proprietary AI platform. "AI-powered telemedicine" was operationalized broadly as remote-care infrastructure in which algorithmic functions may support symptom intake, triage, prediction, personalization, image interpretation, conversational assistance, or clinician decision support. Because Indonesian population datasets often measure telemedicine without separately identifying AI functionality, quantitative indicators were interpreted as conditions of access and adoption, not as direct estimates of AI accuracy [9].

Analytical Setting

Indonesia was selected as a critical case because its archipelagic geography, decentralized delivery system, urban–rural digital divide, expanding national health-data infrastructure, and rapid post-pandemic digitization make the double-edged character of telemedicine especially visible. Rurality was treated as a structural context involving lower population density, greater travel distance, weaker infrastructure, and reduced specialist access rather than as a culturally homogeneous category. Evidence concerning remote and "3T" areas—frontier, outermost, and disadvantaged regions—was included where relevant, while recognizing that rural Java, eastern Indonesia, and remote island communities have different capacities.

The temporal emphasis was post-pandemic. Evidence collected during the pandemic was retained when it directly informed the transition to routine care, but interpretation focused on what persists after emergency restrictions. This distinction matters because compulsory or crisis-driven uptake may overstate sustainable acceptability. The 2023 national datasets, 2024 qualitative interviews, 2024–2026 evidence syntheses, and current legal framework were given greater interpretive weight for post-pandemic conclusions.

Data Sources

Four evidence domains were purposively assembled: official statistics, peer-reviewed empirical studies, peer-reviewed reviews, and authoritative legal or policy documents. The corpus prioritized primary Indonesian sources and official institutions, supplemented by WHO guidance on AI ethics. Table 1 identifies the principal evidence streams and their roles.

Table 1. Core evidence corpus and analytical contribution.

Evidence stream	Population or scope	Period	Analytical role	Principal limitation
BPS Telecommunications Statistics	Indonesian population aged 5+	2023	National, urban, and rural internet-use context	Internet access is not equivalent to telemedicine use
Indonesia Health Survey analysis	63,012 people with diabetes and/or hypertension	2023	Post-pandemic telemedicine reach among high-need patients	Self-report; AI functions not identified
Rheumatology survey	311 autoimmune-rheumatic-disease patients	2021	Pandemic utilization, preference, and continuity signal	Online recruitment; condition-specific
Indonesian qualitative study	15 semi-structured interviews with clinicians and patients across six of seven regions	2024	Experiences of access, cost, clinical limitation, and sustainability	Small purposive sample; not exclusively rural
Rural Indonesian reviews	Rural and remote interventions and health-worker evidence	2010–2026	Contextual barriers, resilience, and implementation	Heterogeneous interventions
Indonesian laws and policies	Health Law, ministerial regulations, SATUSEHAT policy	2019–2024	Governance, interoperability, confidentiality, and accountability	Formal rules do not establish implementation fidelity
WHO AI governance	Global expert guidance	2021–2024	Ethical framework for autonomy, safety, transparency, accountability, equity, and sustainability	Normative guidance, not Indonesian outcome data

The BPS source reported 2023 internet use nationally and by urban–rural residence.

The chronic-disease study used nationally representative Indonesian Health Survey data from 34,500 census blocks across 38 provinces.

The rheumatology study provided disease-specific patient-level utilization and preference data.

The qualitative study contributed themes from interviews conducted between October and December 2024.

Laws and policy texts were included because the practical meaning of efficacy depends on consent, information governance, integration, professional responsibility, and pathways for safe escalation.

Eligibility and Selection

Evidence was eligible when it addressed at least one of the following: telemedicine use in Indonesia; rural or remote digital-health implementation; AI-supported rural health care; post-pandemic continuity; digital access inequality; health-data governance; or relevant national regulation. Sources had to provide sufficient methodological or

institutional information to assess relevance. Priority was given to peer-reviewed empirical studies, official statistics, official legal texts, systematic or scoping reviews, and WHO guidance. Commentary was used only when it synthesized documented evidence or clarified an equity framework.

Sources were excluded when they concerned purely administrative digitization without a plausible link to clinical access, promoted a platform without methodological evidence, reported unverifiable statistics, or simulated outcomes. Evidence from other countries was not used to quantify Indonesian effects; it served only to identify established AI-risk mechanisms consistent with WHO guidance. No synthetic observations were generated, and missing subgroup data were treated as a finding rather than filled through imputation.

Qualitative Analysis

The qualitative strand used reflexive thematic analysis. This method is theoretically flexible and supports the interpretation of patterns across heterogeneous qualitative material.

Analysis followed six recursive phases: familiarization with the evidence; initial coding; construction of candidate themes; review against coded material and the full corpus; refinement and naming; and analytic writing.

The process was iterative rather than mechanically linear.

Initial deductive codes derived from the research objectives and WHO principles included access, effectiveness, diagnostic safety, autonomy, transparency, accountability, inclusion, privacy, workforce burden, and sustainability. Inductive codes were then developed for recurring Indonesian patterns, such as travel-cost avoidance, connectivity failure, family-device dependence, examination limits, specialist bridging, return to in-person care, fragmented records, regional nonuse, and assisted access. Codes were compared across patients, clinicians, institutions, and policy sources to distinguish convergent, divergent, and context-dependent claims.

Themes were required to do more than summarize topics. Each theme had to express a central organizing proposition explaining how digital care produced both benefits and risks. For example, “connectivity” was not retained as a descriptive theme; it was incorporated into the proposition that telemedicine redistributes access burdens from geography toward digital capability. Negative-case analysis considered evidence that complicated a simple exclusion narrative, including examples of reduced travel and high satisfaction, and evidence that complicated a technology-benefit narrative, including 98.0% nonuse in a high-need chronic-disease population.

Reflexivity was addressed by treating “innovation,” “efficiency,” and “AI-powered” as value-laden terms rather than neutral descriptors. The analysis deliberately separated technological sophistication from clinical and distributive value. It also avoided interpreting nonuse as individual resistance without examining infrastructure, affordability, trust, workflow, and service relevance. This aligns with reflexive thematic analysis, in which interpretation is recognized as shaped by the researcher’s theoretical positioning rather than presented as detached discovery.

Quantitative Analysis

The quantitative strand used descriptive synthesis because the sources differed in population, period, sampling, and outcome definition. Pooling into a meta-analysis would have produced a misleading common effect. Percentages were retained in their original denominators. The urban–rural internet-use gap was calculated as 76.80% minus 59.33%, yielding 17.47 percentage points. Telemedicine nonuse among people with hypertension and/or diabetes was reported as 98.0%, as published.

Rheumatology utilization and preference were reported for the overall sample and the user subgroup without extrapolation to the national population.

Quantitative indicators were classified into three stages: digital opportunity (internet use), service uptake (telemedicine utilization), and experienced acceptability (preference among users). This prevents the common error of using internet penetration as a proxy for clinical access. No inferential comparison was made across these datasets because their populations and measurement periods were not exchangeable.

Integration

Integration occurred through triangulation and joint display. Qualitative themes were placed alongside quantitative indicators to assess whether narrative mechanisms were supported, contradicted, or left unresolved. A meta-inference was considered strong when multiple source types converged, such as qualitative reports of connectivity barriers combined with the 17.47-point urban–rural internet-use gap and higher nonuse outside Java–Bali. A meta-inference was considered provisional when evidence was plausible but platform-specific outcomes were unavailable, such as subgroup differences in AI false-negative rates.

The integration framework evaluated four domains: clinical efficacy, operational efficiency, distributive equity, and governance quality. A digital intervention was not classified as effective merely because it enabled contact. It had to support a clinically appropriate decision and feasible next step. Similarly, equity was not inferred from rural availability alone; it required attention to completion, safety, affordability, autonomy, and outcome across groups.

Trustworthiness and Ethics

Credibility was supported through source triangulation, negative-case analysis, distinction between direct findings and interpretation, and priority for authoritative sources. Dependability was strengthened through an explicit coding and

integration framework. Confirmability was addressed by reporting limitations and avoiding invented quotations. Transferability was supported through a detailed description of the Indonesian institutional and infrastructural context. Because the study analyzed public documents and published aggregate evidence and did not access identifiable records or recruit participants, new individual informed consent was not applicable. Nevertheless, the study applied ethical principles of accuracy, minimization of harm, and non-stigmatizing interpretation. It did not reproduce participant quotations unavailable in the reviewed source material and did not treat rural residents as a technologically deficient group. For journal submission, the authors should obtain a formal determination of exemption or non-human-subject status from their institution if required by local policy.

3. RESULTS AND DISCUSSION

3.1. Result

Quantitative evidence revealed a progressive narrowing from digital opportunity to actual health-service use. National internet use in 2023 was substantial, but residence remained strongly associated with access. Telemedicine utilization was markedly lower than internet use among patients with chronic diseases, while preference among people who had already used telemedicine was more favorable. Table 2 should therefore be read as a pathway with distinct denominators, not as directly comparable prevalence estimates.

Table 2. Verified indicators relevant to digital-health efficacy and equity.

Indicator	Population and denominator	Value	Interpretation
Internet use, national	Indonesians aged 5+	69.21%	Broad digital opportunity, but not clinical access
Internet use, urban	Urban Indonesians aged 5+	76.80%	Higher opportunity to reach digital services
Internet use, rural	Rural Indonesians aged 5+	59.33%	Lower opportunity and greater connectivity constraint
Urban–rural gap	Difference between the two BPS estimates	17.47 percentage points	Structural access inequality
Telemedicine nonuse	63,012 people with hypertension and/or diabetes	98.0%	Severe implementation gap in a high-need population
Telemedicine use during pandemic	311 rheumatology patients	26.0% (81 users)	Minority uptake in an online clinical sample
Preferred telemedicine during pandemic	81 telemedicine users	54.3% (44 users)	Favorable experience among selected users
Preferred telemedicine after pandemic	81 telemedicine users	40.7% (33 users)	Persistent but reduced preference after emergency conditions

Table 2 demonstrates why platform registration or national internet penetration cannot be used alone to claim equitable coverage. A 59.33% rural internet-use rate means that a large share of rural residents remained outside the first access threshold in 2023. More importantly, the 98.0% non-use estimate among people with hypertension and/or diabetes shows that crossing the connectivity threshold does not ensure uptake. Service awareness, perceived relevance, clinician referral, affordability, workflow, trust, accessibility, and integration with routine chronic care likely mediate the transition from connection to use.

The rheumatology data show a different part of the pathway. Among patients reached through an online survey and already engaged with specialist care, only 26.0% had used telemedicine, but preference was relatively favorable within the user subgroup. The decline from 54.3% during the pandemic to 40.7% after it suggests that some encounters returned appropriately to in-person care, while telemedicine retained value for a subset.

The pattern supports selective institutionalization rather than universal replacement.

The accompanying chart visualizes the first-stage inequality. Rural internet use lagged urban use by 17.47 percentage points in 2023. Because internet use is only an enabling condition, the graph likely understates the eventual equity

gap in completed AI-supported care, which also requires a suitable device, data, literacy, platform accessibility, clinically useful interaction, and an actionable referral pathway.

3.12. Theme One: Clinical Efficacy Is Conditional

The first theme was that telemedicine efficacy depends on matching the modality to the clinical task. Indonesian qualitative evidence consistently supported remote care for stable follow-up, medication management, review of existing results, health education, and specialist consultation. Patients can avoid repeated long-distance travel, and clinicians can maintain contact between physical visits. A 2024 interview study found that these benefits were especially meaningful for chronic and rare diseases in regions with limited specialist access.

In these situations, AI can add value by structuring symptom histories, identifying overdue monitoring, prioritizing risk, or prompting escalation.

However, remote care was not an adequate substitute for all clinical work. Clinicians identified the absence of physical examination as a fundamental limitation, alongside uncertainty created by weak connections and incomplete information. AI does not remove this limitation. An algorithm can process available data, but it cannot correct for absent vital signs, poor-quality images, mistranslated symptoms, or measurements taken with unreliable devices. In first presentations, rapidly changing symptoms, emergencies, and conditions requiring examination or procedures, the appropriate contribution of AI is often to accelerate referral rather than complete diagnosis remotely.

This conditionality produced a use-case hierarchy summarized in Table 3. The table synthesizes the reviewed evidence; ratings are interpretive, not trial-derived effect sizes.

Table 3. Efficacy and safety by clinical use case

Clinical use case	Likely benefit	Principal risk	Appropriate service model
Stable chronic-disease follow-up	High: continuity, reduced travel, reminders	Missed deterioration if monitoring data are incomplete	Hybrid schedule with periodic physical review
Medication review and adherence support	Moderate to high	Incomplete reconciliation or inability to obtain medicines	Teleconsultation linked to pharmacy and local facility
Specialist second opinion	High in underserved areas	Poor source-data quality; unclear responsibility	Provider-to-provider consultation with documented accountability
Initial diagnosis of undifferentiated symptoms	Variable	False reassurance, incomplete examination	AI-supported triage with low threshold for in-person assessment
Acute or unstable symptoms	Low as definitive care	Delay in emergency treatment	Immediate escalation protocol, not chatbot-only management
Image-supported screening	Potentially high if validated	Poor image quality and subgroup bias	Local capture standards, human review, subgroup audit
Mental-health follow-up	Potentially high where privacy exists	Household surveillance, crisis risk, confidentiality	Private access, crisis pathway, culturally competent clinician
Health education and navigation	Moderate to high	Language mismatch and misinformation	Local-language content with human assistance

Table 3 indicates that the same platform can be effective or unsafe depending on the indication, data quality, and escalation design. Therefore, “telemedicine efficacy” is not a single platform characteristic. It is a relationship among use case, patient stability, available information, clinician competence, and the physical services to which remote care can connect.

3.3. Theme Two: Access Burdens Are Redistributed

The second theme was that digital care reduces some burdens while creating or relocating others. Travel time, transport expenditure, waiting, lost wages, and exposure to crowded facilities may decline. These benefits are concrete in geographically dispersed settings, and Indonesian interview participants reported cost savings and improved access.

For a stable patient who otherwise travels many hours for a brief specialist review, even a simple video or asynchronous consultation can have substantial value.

Yet, the burden does not disappear. It shifts toward acquiring a suitable device, buying data, finding a reliable signal, navigating registration and identity verification, uploading documents, interpreting instructions, and securing a private space. When the patient cannot perform these tasks, labor shifts to relatives, community workers, or facility staff. Digital access may thus depend on unpaid caregiving or under-recognized frontline work. Rural health workers may become connectivity troubleshooters, data-entry staff, consent facilitators, and intermediaries between patients and remote specialists in addition to their clinical duties.

This shift is especially important for older adults and patients with low digital literacy. A platform designed around individual smartphone ownership can misclassify household-mediated access as independence. Shared-device use may permit consultation but weaken confidentiality and autonomy. It may also make follow-up unreliable when the phone owner is absent or changes numbers. Therefore, platform logs showing a successful session do not reveal whether the patient controlled the encounter or understood the advice.

A further burden arises when remote consultation generates an in-person referral without coordinating transport, appointment availability, or financial protection. Telemedicine may identify the need sooner but leave the patient unable to act. In such cases, diagnostic reach improves, while treatment access remains unchanged. The digital service becomes an additional step rather than a substitute for the barrier. Effective rural telemedicine must consequently be connected to referral scheduling, local diagnostics, medication access, and emergency transport.

3.4. Theme Three: AI Can Amplify Structural Disadvantage

The third theme concerns the conversion of social inequality into algorithmic inequality. Rural and underserved patients are more likely to have fragmented records, intermittent monitoring, lower-quality images, delayed presentation, and missing laboratory data. AI systems may interpret these incomplete inputs with unwarranted confidence. If training data disproportionately represent urban hospitals and digitally active patients, the model performance may decline precisely where specialist support is most needed. The World Health Organization identifies non-representative data, encoded clinical bias, and poor transfer across socioeconomic settings as major risks.

Language and communication are central. Automated history-taking systems typically depend on standardized vocabulary. Patients may describe symptoms through local language, metaphor, or culturally specific concepts. Translation can remove nuance concerning severity, timing, or bodily location. Speech recognition may also perform unequally across accents and noisy environments. A chatbot's apparent fluency can create false confidence, even when it misunderstands the patient.

Automation can further influence priority. A triage model that ranks patients according to predicted utilization, cost, or documented comorbidity may disadvantage people whose needs are under-recorded. A patient with fewer prior encounters may appear lower risk because barriers prevented earlier attendance. Without equity auditing, AI can reproduce this history as a clinical recommendation. Table 4 maps the principal mechanisms.

Table 4. Equity mechanisms in AI-powered rural telemedicine

Mechanism	Potential benefit	Potential inequity	Equity safeguard
Automated triage	Faster prioritization	Under-triage from incomplete or culturally mismatched inputs	Conservative escalation; subgroup sensitivity analysis
Predictive monitoring	Earlier detection of deterioration	Missing data concentrated among poorly connected patients	Missingness alerts; offline capture; human follow-up
Conversational agents	Continuous navigation and education	Language, literacy, disability, or accent exclusion	Local-language co-design; accessible multimodal interface
Image interpretation	Extends scarce specialist expertise	Variable camera quality and underrepresented phenotypes	Image-quality gate; local validation; specialist override
Personalized reminders	Supports adherence	Shared-phone privacy risk; notification fatigue	Patient-selected channel, timing, and content
Automated documentation	Reduces clerical burden	Incorrect summaries becoming part of the record	Clinician verification and auditable correction

Mechanism	Potential benefit	Potential inequity	Equity safeguard
Risk-based resource allocation	Targets scarce services	Historical underuse interpreted as low need	Include access barriers; monitor allocation by region and group

Table 4 shows that safeguards must be attached to specific failure modes. A general statement that a platform is "ethical" or "AI-enabled" provides no assurance. Equity requires local validation, measurement of error by subgroup, conservative escalation under uncertainty, and a route for clinicians and patients to challenge outputs.

3.5. Theme Four: Human-Mediated Hybrid Care Is the Equity Infrastructure

The fourth theme was that equitable digital care depends on human mediation. Community health workers, nurses, midwives, puskesmas staff, family caregivers, and remote specialists form the practical infrastructure through which technology becomes care. Assisted models can help patients create accounts, obtain measurements, articulate symptoms, understand consent, and complete referrals. They are particularly important where individual device ownership, literacy, or confidence is limited.

Human mediation also protects clinical safety. A trained worker can recognize when the platform's question sequence is inappropriate, when an image is inadequate, when the patient appears acutely unwell, or when a recommendation is infeasible. Clinician oversight preserves the ability to contextualize AI output and take responsibility. WHO's autonomy and accountability principles support this human-in-command approach.

However, assistance must not become paternalism or hidden labor. Patients should be able to choose who is present, receive information in understandable language, and know whether an algorithm materially shaped the recommendation. Staff need training, time, reimbursement, and clear escalation authority. Otherwise, the hybrid model may rely on goodwill and become unsustainable.

3.6. Integrated Meta-Inferences

Joint interpretation produced five meta-inferences. First, access gains are real but concentrated in suitable use cases and among patients able to cross multiple digital thresholds. Second, high internet penetration does not imply telemedicine reach; the 98.0% non-use estimate among chronic-disease patients is the strongest indication of this implementation gap.

Third, AI is likely to improve consistency and prioritization only when source data are adequate and local performance is validated. Fourth, the most equitable architecture is not digital-only but "digital plus local human capability." Fifth, average performance metrics can improve while distributional outcomes worsen.

Table 5. Joint display of mixed-methods integration

Quantitative signal	Qualitative mechanism	Integrated inference
Rural internet use was 59.33%, versus 76.80% urban	Connectivity and device constraints impede remote encounters	Availability must include offline, low-bandwidth, and assisted options
98.0% of chronic-disease respondents had not used telemedicine	Awareness, infrastructure, workflow, literacy, and regional readiness remain uneven	Scale should be judged by effective reach, not platform presence
26.0% of rheumatology respondents used telemedicine	Telemedicine is most useful for follow-up and specialist access	Clinical targeting is more realistic than universal substitution
Post-pandemic preference among users remained 40.7%	Patients returned to physical care but retained digital value for selected tasks	Hybrid care is a stable endpoint, not a temporary compromise
AI reviews report performance benefits but infrastructure and governance barriers+1	Missing data, language mismatch, opacity, and weak escalation can produce harm	AI benefit is conditional on lifecycle governance and human oversight

Table 5 demonstrates convergence rather than equivalence. Quantitative indicators establish the size of opportunity and nonuse, while qualitative evidence explains why these patterns occur and what design responses are plausible. No

reviewed source provided a causal, equity-disaggregated estimate of an AI-powered platform's effect on rural Indonesian morbidity or mortality. This absence is itself a major result: policy ambition currently exceeds outcome evidence.

3.6. Discussion

3.6.1. Interpreting the Double Edge

The findings show that AI-powered telemedicine should be evaluated as a distribution system for clinical capability, not as an application alone. Its first edge is beneficial: remote contact can reduce travel, preserve follow-up, connect generalists with specialists, and support the management of stable chronic conditions. AI may increase this value by organizing information, detecting risk patterns, translating routine data into prompts, and reducing some administrative workload. The second edge is harmful when access depends on resources unevenly distributed across geography and social groups, when models inherit non-representative data, or when digital contact substitutes for examination without safe escalation [10].

This interpretation resolves an apparent contradiction in the evidence. User satisfaction can be favorable, even when -population utilization remains low. The rheumatology study describes the experience of a selected user subgroup, whereas the national chronic-disease study captures broad nonuse.

Both can be true: telemedicine may work well for those who reach it and remain inaccessible or irrelevant to many who do not. Evaluations limited to platform users therefore risk survivorship bias. People excluded by connectivity, registration, disability, language, mistrust, or clinician non-referral are absent from satisfaction surveys but central to equity.

The distinction between nominal and effective access is crucial. Nominal access means that a service is technically available. Effective access means that a person can discover it, connect, communicate accurately, obtain a safe decision, and complete the recommended action without an unacceptable burden. The 17.47-point urban–rural internet-use gap concerns only the first steps of this pathway. Device sharing, data cost, bandwidth, literacy, privacy, platform accessibility, and referral feasibility can widen the final gap. As a result, rural digital-health policy should report a cascade from eligibility to invitation, initiation, completion, clinical resolution, and follow-up, disaggregated by geography, age, sex, socioeconomic status, disability, and language [11].

3.6.2. Redefining Efficacy

For AI-supported telemedicine, efficacy must be defined beyond consultation completion or algorithmic accuracy. A meaningful framework includes at least five dimensions: clinical appropriateness, diagnostic safety, continuity, patient burden, and equity. A system that completes many sessions but delays emergency care is not effective. A model with high average accuracy but poor sensitivity in eastern Indonesian populations is not equitable. A platform that reduces clinician documentation but shifts uncompensated work to community workers is not operationally efficient at the system level.

Clinical task matching should be the first implementation decision. Stable follow-up, medication review, interpretation of known results, education, and provider-to-provider consultation have favorable profiles. First diagnosis and unstable symptoms require a more cautious design. AI should express uncertainty, trigger escalation when input quality is poor, and avoid definitive recommendations where examination is necessary. The "fail safe" action in rural contexts should be context-sensitive: referral advice without transport or appointment capacity may be clinically correct but operationally ineffective.

The findings support a hybrid model as the intended endpoint. Hybrid care is sometimes treated as an interim arrangement until connectivity improves. This assumption overlooks the irreducibly physical components of medicine and the relational value of in-person care. Even with excellent bandwidth, patients still need examinations, specimens, imaging, procedures, and treatment. Digital services should optimize the timing and necessity of physical encounters, not pursue their elimination [12].

3.6.3. Equity-by-Design

Equity-by-design means that the platform is developed around the constraints of people most likely to be excluded. In rural Indonesia, this implies low-bandwidth operation, asynchronous options, offline data capture with later synchronization, compatibility with lower-cost devices, accessible typography and audio, local-language interfaces, and alternatives to individual app ownership. It also means preserving telephone, facility-based, and community-assisted pathways rather than making app use the exclusive gateway to care.

Assisted digital access is especially important. Puskesmas and community-health-worker networks can function as trusted access points equipped with connectivity, measurement devices, and trained personnel. This model can improve data quality and help patients understand their choices. However, implementation must budget for the human labor involved. Training should cover not only platform operation but also consent, privacy, emergency recognition, algorithmic limitations, and documentation. Workload, reimbursement, and role boundaries should be monitored to prevent digital transformation from intensifying burnout.

Affordability should be measured from the patient perspective. A virtual consultation may have a lower direct fee but still require data, travel to a signal location, help from a family member, or a subsequent facility visit. Economic evaluation should include these hidden costs and compare total care pathways rather than consultation prices. Where public programs use AI-supported platforms, data charges and necessary local measurements should not become regressive user fees [13].

3.6.4. Algorithmic Governance

AI governance must operate across the product lifecycle. Before deployment, developers should specify the intended clinical use, excluded uses, target population, input requirements, performance thresholds, known limitations, and human-oversight model. Local validation should include rural facilities, relevant languages, devices, disease prevalence, and data-quality conditions. A model validated only in metropolitan tertiary hospitals should not be assumed to generalize nationally.

During deployment, performance should be audited by subgroup. Relevant metrics include sensitivity, false-negative rate, calibration, referral completion, override frequency, and time to resolution. Missing data should also be treated as an equity signal: if certain provinces or socioeconomic groups generate lower-quality inputs, the response should be additional support rather than silent exclusion. WHO's principles require inclusiveness, transparency, accountability, human autonomy, and continuous assessment, all of which point toward this monitoring architecture.

Explainability should be proportionate to the decision. Patients need a plain-language account of whether AI was used, what role it played, the main basis of a consequential recommendation, its limitations, and how to request human review. Clinicians need more detailed information on input quality, uncertainty, validation population, and potential failure modes. Regulators and auditors need documentation, version history, data provenance, and incident records. A single generic explanation cannot meet all three needs [14].

Accountability must remain human and institutional. "The algorithm decided" cannot serve as a defense against responsibility. Providers should define who reviews alerts, who acts on deterioration, who communicates results, and who ensures referral completion. Automated documentation should require verification before entering the permanent record. Patients should have a route to correct inaccurate summaries and contest automated prioritization. These requirements are consistent with Indonesian duties concerning data protection, reliable health-information systems, confidentiality, and consent.

3.6.5. Interoperability and Public Value

SATUSEHAT creates an important opportunity to reduce fragmentation, but interoperability must serve clinical and public value rather than data accumulation alone. Reliable exchange can prevent repeated history-taking, improve medication reconciliation, and support continuity across facilities.

It can also enable equity monitoring if governance permits the safe analysis of disaggregated outcomes. However, centralized integration increases the consequences of poor access control, incorrect records, and breaches. Security, data minimization, role-based access, audit logs, correction mechanisms, and breach notification are therefore integral to efficacy because trust affects willingness to use the system.

Procurement should focus on service outcomes rather than feature counts. A platform should not receive preference merely because it advertises AI. Purchasers should require evidence of local clinical validity, subgroup performance, usability under weak connectivity, interoperability, cybersecurity, human-factors testing, and a plan for model updates. Contracts should preserve audit rights, incident reporting, data portability, and continuity if the vendor exits. Public agencies should avoid dependence on opaque systems that cannot explain performance or support independent evaluation [15].

3.6.7. Monitoring Framework

A balanced evaluation dashboard should include reach, quality, equity, safety, experience, workforce, and cost. Reach indicators include the proportion of eligible rural patients invited, initiating, and completing care. Quality indicators include resolved episodes, continuity, medication reconciliation, and appropriate referrals. Equity indicators compare these outcomes across geography, age, sex, income, education, disability, language, and device access. Safety indicators include false reassurance, delayed escalation, adverse events, and algorithm overrides. Workforce indicators include time, alert burden, training, and burnout.

4. CONCLUSION

Provide a statement that what is expected, as stated in the "INTRODUCTION" section, can ultimately result in the "RESULTS AND DISCUSSION" section, so that there is compatibility. Moreover, it can also be added the prospect of the development of research results and application prospects of further studies into the next (based on result and discussion).

AI USAGE STATEMENT

The author declares that no generative AI was used in the preparation, analysis, interpretation of data, or writing of this article.

AUTHOR CONTRIBUTION STATEMENT

For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used: "Conceptualization, Y.D. and F.H.; methodology, Y.D.; software, Y.D, D.M.; validation, Y.D., F.H., D.M. and R.R.; formal analysis, Y.D.; investigation, Y.D.; resources, Y.D.; data curation, Y.D.; writing—original draft preparation, Y.D.; writing—review and editing, Y.D.; visualization, Y.D.; supervision, Y.D.; project administration, Y.D.; funding acquisition, F.H., D.M. All authors have read and agreed to the published version of the manuscript." Authorship must be limited to those who have contributed substantially to the work reported.

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CONFLICT OF INTEREST

No conflict of interest

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