

ORIGINAL RESEARCH ARTICLE

Impact of Telemedicine on Healthcare Accessibility and Patient Outcomes in Underserved Populations: A Systematic Literature Review

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ABSTRACT

Background: Telemedicine has moved from a peripheral innovation to a routine mode of care delivery. Its promise for underserved populations is that it replaces geographic distance with digital connection. Whether that promise is realised depends on more than technology, and the evidence on access and clinical outcomes in disadvantaged groups remains scattered across disciplines.

Objective: This review synthesises evidence on how telemedicine affects (i) the accessibility of healthcare and (ii) patient outcomes in underserved populations. It also examines the conditions under which telemedicine narrows or widens existing inequities.

Methods: The review followed PRISMA 2020 reporting principles and drew on scoping-review conventions. The pool comprised 148 records: an author-curated corpus of 117 and 31 supplementary landmark sources. Eligibility screening against pre-specified criteria retained 63 records. They comprised 14 review-level evidence syntheses, 17 conceptual, policy and methodological sources, and 32 contextual scholarly works. Findings were analysed through narrative synthesis and organised using a multidimensional access framework. Reviews were appraised against AMSTAR 2 principles.

Results: Review-level evidence consistently shows that telemedicine achieves clinical outcomes comparable to in-person care for many conditions. For heart failure, diabetes and common mental disorders it often achieves better outcomes than usual care. Patient satisfaction is generally high. Access gains are real but unevenly distributed. Older, poorer, rural, linguistically marginalised and digitally unconnected groups use video-based care less, so telemedicine can reproduce inequity even as it removes distance barriers. Outcomes depend on infrastructure, digital literacy, regulatory clarity, workforce readiness, and the design of the service pathway.

Conclusion: Telemedicine is best understood as an access-reconfiguring technology, not an access-guaranteeing one. This review proposes the access displacement principle: the technology moves barriers from the geographic domain to the digital, institutional and social domains. It argues that equity must be built into the design of telemedicine services from the start. Recommendations are given for policy, practice and research.

Keywords: *telemedicine; telehealth; healthcare accessibility; health equity; underserved populations; digital divide; patient outcomes; systematic review; PRISMA*

1. INTRODUCTION

Telemedicine is the delivery of clinical services across distance through information and communication technologies. The World Health Organization describes it as a means of overcoming geographical barriers and extending the reach of health services to people who would otherwise lack them [1]. The idea is old. Early commentators were already weighing the promise of remote consultation against its practical uncertainties in the mid-1990s, and offered what one author called a cautious welcome to the field [2]. For decades, adoption stayed modest, confined to pilot projects, specialist networks and remote-area programmes. Policy interest in digital health nonetheless kept growing. It culminated in a global strategy that positions digital technologies as instruments for strengthening health systems and advancing universal health coverage [3].

The COVID-19 pandemic changed this trajectory abruptly. Health systems needed to maintain continuity of care while limiting physical contact, and regulatory, reimbursement and organisational barriers that had held back virtual care for years were suspended or relaxed within weeks [4]. Commentators described the shift as a rapid, system-wide experiment in virtual care that showed what telemedicine could do under pressure [5]. As emergency conditions recede, a more consequential question has replaced the question of feasibility. The question is no longer whether telemedicine can work. It is for whom it works, under what conditions, and with what consequences for those already disadvantaged.

This question matters most for underserved populations. People living in remote and rural settings, urban poor communities, older adults, people with disabilities, migrants and displaced groups, and populations facing linguistic or socio-economic marginalisation tend to carry a disproportionate burden of disease while having the least access to care. In India, the combination of a large and changing disease burden [6] and shifting epidemiological patterns that bring communicable, non-communicable and emerging challenges together [7] creates sustained pressure on health systems. Regional analyses show that inequities within states can be sharp, with structural, legislative and institutional factors shaping who receives timely care [8]. Telemedicine is often proposed as a corrective to these inequities. Yet work on digital health equity has argued that access to and outcomes from telemedicine themselves differ across socio-economic groups, and that digital delivery should not be assumed to be neutral [9].

Public discussion often treats the digital divide as a preface to the evidence. It is better treated as one of the central findings. Analyses of the pandemic-era shift to virtual care documented how unequal connectivity, devices and digital skills determined who could participate [10]. A broader informatics literature warns that interventions designed with good intentions can widen inequality when they are taken up first, or best, by already advantaged groups [11]. National regulation has recognised some of these risks. India's telemedicine practice guidelines, for example, set out professional, ethical and procedural expectations for registered practitioners delivering care remotely [12].

Three gaps motivate the present review. First, evidence on telemedicine effectiveness is abundant, but it is largely organised by clinical condition or by technology type. Few syntheses ask the cross-cutting question of how effectiveness and access interact within underserved populations. Second, effectiveness reviews and equity analyses seldom speak to one another. Effectiveness studies often report average effects, and equity studies often report uptake patterns without outcome data. Third, research from low- and middle-income settings, including India, is underrepresented in the international evidence base, even though these settings stand to gain or lose the most.

This systematic literature review addresses three research questions:

- **RQ1:** What does the available review-level evidence show about the effect of telemedicine on healthcare accessibility in underserved populations?
- **RQ2:** What does it show about patient outcomes (clinical outcomes, satisfaction, and safety) in these populations?
- **RQ3:** Which individual, organisational, technological and policy factors determine whether telemedicine narrows or widens inequities?

The review makes four contributions. It integrates effectiveness and equity evidence in a single analytical frame. It provides a comparative matrix of related research reviews and their results. It analyses the evidence from patient, provider, health-system, policy-legal and technology-ethics perspectives. And it offers a set of propositions that can be cited, tested and refined in future research.

2. Conceptual Background and Analytical Framework

2.1 Defining access

Access to care is a multi-dimensional concept and cannot be reduced to proximity. A classic formulation identifies five dimensions: availability, accessibility, accommodation, affordability and acceptability, and links each to how consumers experience care [13]. A later, patient-centred formulation treats access as the fit between the characteristics of services and the abilities of people. On this view, a person must be able to perceive a need, seek care, reach services, pay for them and use them effectively. Corresponding dimensions on the service side include approachability, acceptability, availability, affordability and appropriateness [14]. A third influential

strand, the behavioural model of health service use, distinguishes predisposing, enabling and need factors, and separates potential from realised access [15]. Together these frameworks make a simple point. Access is realised only when abilities and services meet.

Telemedicine acts directly on only some of these dimensions. It improves geographic availability and can reduce travel cost and time. It may improve acceptability for people who fear stigma or discrimination in physical clinics, a pattern relevant to stigmatised conditions. But it introduces new ability requirements: a device, connectivity, digital literacy, a private space, trust in virtual interaction, and often a shared language of interface and instruction. This asymmetry is the root of the equity paradox examined throughout this review.

2.2 Technology adoption and non-adoption

A widely used framework for studying health technologies identifies several interacting domains. They are the condition, the technology, the value proposition, the adopter system, the organisation, the wider system, and the embedding and adaptation of the technology over time. It was developed to explain why technologies are abandoned or fail to scale despite promising pilots [16]. It reminds the reviewer that telemedicine outcomes are products of a socio-technical system and cannot be read from the technology alone. A video platform that works well in an urban tertiary hospital may fail in a primary health centre with intermittent power, a single shared device and staff who have not been trained to run virtual clinics.

2.3 Rural and underserved contexts

Reviews of rural telehealth have argued that it can address disparities by bringing specialist expertise to communities that lack it, particularly in paediatric and subspecialty care. They also stress that success depends on local infrastructure, sustainable financing and integration into existing referral networks [17]. This pattern is not confined to rural settings. Urban slum populations, internally displaced communities and groups affected by disasters face parallel barriers of cost, documentation, mobility and trust.

2.4 Health-system and governance context

Telemedicine operates inside health systems. Analyses of digital transformation in hospital management emphasise that technology adoption interacts with workflow redesign, workforce capacity, information governance and organisational culture [18]. Health legislation shapes the legal environment in which remote care is delivered, covering licensure, consent, data protection and liability. Policy-legal analyses stress that strong legal architecture is a precondition for sustainable health-system strengthening [19]. Leadership matters as well. Studies of healthcare leadership and management highlight how leadership styles in hospital administration condition the adoption and sustainability of change [20]. Experience from pandemic-era crises suggests that organisational learning, and not just technology, determines whether emergency innovations are retained and improved [21].

2.5 The analytical framework used in this review

The review applies a three-layer framework. The first layer is the **access layer**, covering the five dimensions above as they are changed by telemedicine. The second is the **outcome layer**, covering clinical effectiveness, patient experience and safety. The third is the **equity layer**, which asks how the first two vary across population subgroups defined by geography, income, age, language, gender, disability and digital capability. Throughout the analysis, results are interpreted through the interaction of the three layers and not in isolation.

3. Methods

3.1 Design and reporting standard

The review is a systematic literature review of reviews and related scholarly sources. Reporting follows the PRISMA 2020 statement for transparent reporting of systematic reviews [22]. Because the research questions are broad and the evidence base is heterogeneous across clinical conditions, technologies and settings, scoping-review conventions were also used to chart and map the literature. The relevant extension for scoping reviews supports this mapping approach [23]. Accessible methodological accounts of transparent mapping and structured exploration of research landscapes informed the design of the charting process [24,25]. A formal prospective registration was not undertaken, and this is acknowledged as a limitation.

3.2 Eligibility criteria

Eligibility was specified using a population, intervention, comparator, outcome and study-design structure (Table 1). The emphasis on review-level evidence reflects the aim of mapping the weight of evidence efficiently, without re-analysing hundreds of primary trials. Contextual and conceptual works were retained where they informed the access, outcome or equity layer of the framework.

Table 1. Eligibility criteria used for record selection

Element	Inclusion criteria	Exclusion criteria
Population	Underserved or disadvantaged groups: rural/remote residents, low-income, older adults, minority/linguistically marginalised, displaced or disaster-affected, and populations in low- and middle-income settings; also general populations where subgroup or equity analysis is reported	Records with no health-service or population-health relevance
Intervention	Telemedicine, telehealth, telemonitoring, tele-mental health, structured telephone support, and directly related digital-health delivery	Purely administrative, educational or entertainment technologies with no care-delivery link
Comparator	Usual (in-person) care, no care, or other service model; descriptive works without comparator were retained only where conceptually informative	None specified
Outcomes	Access (availability, affordability, acceptability, utilisation), clinical outcomes, patient satisfaction, safety, and equity-relevant determinants	Records reporting no outcome, process or determinant relevant to access, outcomes or equity
Study type	Systematic reviews, meta-analyses, reviews of reviews, technical briefs, policy and legal analyses, conceptual frameworks, methodological guidance, and contextual scholarly analyses	Incomplete or unverifiable records; commentary with no analytical content
Language and period	English-language or English-abstracted; publications from 1981 onward for conceptual works and 2007 onward for evidence syntheses	Records without bibliographic details sufficient to verify

3.3 Information sources and search strategy

Two information sources were used. The first was an author-curated corpus of 117 bibliographic records, assembled by the research team across health, social-science and policy domains. The second was a targeted supplementary retrieval of landmark evidence syntheses, conceptual frameworks and policy documents, identified through citation chaining from the corpus and through topical knowledge of the field. This produced 31 additional records.

For readers who wish to replicate or extend the review, a recommended database protocol is as follows. The search would combine concept blocks for telemedicine (telemedicine OR telehealth OR "remote consultation" OR telemonitoring OR "virtual care"), for underserved groups (underserved OR rural OR "low-income" OR "health disparities" OR "digital divide" OR "health equity"), and for design (systematic review OR meta-analysis OR "review of reviews"). It would be run in PubMed/MEDLINE, Embase, CINAHL, Scopus, Web of Science and the Cochrane Library, with grey literature searched through the websites of international health agencies and national ministries. This protocol is offered as a replication template and not as a description of work already performed.

3.4 Selection process

All 148 records were screened against the criteria in Table 1. Screening proceeded in two stages, a title and scope check followed by a bibliographic and conceptual eligibility check. The PRISMA flow of records is shown below.

IDENTIFICATION

Records in author-curated corpus n = 117

Supplementary landmark records (citation chaining) n = 31

Total records identified n = 148
 Duplicates removed n = 0

SCREENING

Records screened (title/scope) n = 148
 Records excluded (outside topical scope) n = 85
 – domains excluded: yoga and contemplative practice,
 higher-education accreditation, commercial and tort
 law, geopolitics, culture and literature, and others
 – one incomplete/unverifiable bibliographic record

ELIGIBILITY

Records assessed for eligibility n = 63
 Records excluded after assessment n = 0

INCLUDED

Records included in synthesis n = 63
 – Review-level evidence syntheses (primary evidence) . n = 14
 – Conceptual, policy and methodological sources n = 17
 – Contextual scholarly works (health systems,
 equity, digital society, disease burden) n = 32

3.5 Data charting and quality appraisal

For each included record, data were charted on the following: focus and scope, evidence base (number and design of studies, where reported), principal findings, and relevance to the access, outcome and equity layers. The 14 review-level syntheses were appraised using the logic of AMSTAR 2, which examines protocol registration, comprehensiveness of search, duplicate selection, risk-of-bias assessment, appropriateness of synthesis methods and consideration of bias in interpreting results [26]. Appraisal was used to weight interpretation and was not used to exclude records. Formal numerical scoring was not applied, since many included syntheses pre-date the AMSTAR 2 instrument.

3.6 Synthesis approach

A narrative synthesis was used because the evidence is heterogeneous in conditions, interventions, comparators and outcome measures, and quantitative pooling would not be defensible. The synthesis followed established guidance on narrative synthesis: developing a preliminary synthesis, exploring relationships within and between records, and assessing the robustness of the synthesis [27]. Findings from the three framework layers were compared across record types, and divergences between effectiveness and equity evidence were examined explicitly.

3.7 Ethical considerations

The review used published literature only and involved no human participants. Ethical conduct nevertheless required attention to accurate representation of sources, avoidance of selective reporting, transparent disclosure of limitations and appropriate acknowledgement of intellectual contributions, in line with recognised standards for ethical practice in social-science research [28].

4. Results

4.1 Study selection and corpus characteristics

Of 148 records identified, 85 were excluded as outside the topical scope. The excluded records concerned subjects such as contemplative practices, accreditation systems in higher education, commercial and criminal law, international relations, cultural studies and literature, and one bibliographic entry too incomplete to verify. Sixty-three records were retained. The 14 review-level syntheses spanned 2007 to 2023 and covered chronic disease management, mental health, general clinical effectiveness, patient satisfaction and barriers to adoption. The remaining records provided conceptual, policy, methodological and contextual material on health systems, disease burden, equity, digital society and the ethics of technology.

The review-level evidence is geographically concentrated. Most syntheses draw predominantly on studies from North America, Europe, Australia and parts of East Asia, with limited representation of South Asia and sub-Saharan Africa. This imbalance limits direct transferability to low- and middle-income contexts and is discussed in Section 6.

4.2 Related research reviews and their results

4.2.1 General effectiveness and reviews of reviews

An early systematic review of reviews examined the effectiveness of telemedicine across applications. Its conclusion was nuanced. Evidence of benefit was strongest for some applications, notably telemonitoring in chronic conditions and psychiatric services, but many reviews found the underlying primary evidence insufficient or of low quality, and the authors cautioned against sweeping claims of effectiveness [29]. A later comprehensive review of the empirical foundations of telemedicine for chronic disease management synthesised the evidence by condition. It found that telemedicine was effective or promising for many chronic conditions, with the strongest results in conditions where regular monitoring and behaviour change were central [30].

A Cochrane review of interactive telemedicine, covering real-time and store-and-forward modalities, reached several conclusions relevant to accessibility and outcomes. For people with type 2 diabetes, telemedicine-supported management was associated with a modest but clinically meaningful improvement in glycaemic control, on the order of 0.3 percentage points in glycated haemoglobin. In heart-failure management, outcomes were comparable to usual care, and for some other conditions the evidence was too limited for firm conclusions [31]. This is an important benchmark for the present review. It shows that effect sizes, where they exist, are often modest and condition-specific, a pattern that should temper both enthusiastic and sceptical readings.

4.2.2 Heart failure and telemonitoring

Heart failure provides some of the clearest comparative data. A Cochrane review of structured telephone support and non-invasive telemonitoring in heart failure reported that telemonitoring was associated with a reduction in all-cause mortality of roughly one fifth, and a reduction in heart-failure-related hospital admission of close to 30%, relative to usual care. Structured telephone support also showed a smaller but significant mortality benefit [32]. A systematic review of home telemonitoring for chronic diseases, drawing on a broader set of conditions, found evidence of improved blood-pressure control in hypertension and improved glycaemic control in diabetes, as well as reduced hospitalisations in heart failure [33]. For underserved populations, in which hospital access may be distant, delayed or financially catastrophic, avoiding admissions has a particular significance. It reduces exposure to out-of-pocket costs and supports continuity of care.

4.2.3 Patient satisfaction

A systematic review of telehealth and patient satisfaction concluded that satisfaction was generally high across modalities and settings. Patients cited convenience, reduced travel, time savings and comfort as drivers, and a minority expressed concern about the loss of physical examination or personal contact [34]. This finding matters for acceptability, but it carries a selection caveat. Satisfaction is typically measured among patients who used the service, and non-users are not captured, so satisfaction data say little about the people excluded from telemedicine by lack of devices or skills.

4.2.4 Mental health

Mental health has been one of the most thoroughly studied areas of telemedicine. A review of telemental health found that videoconferencing-based services produced outcomes comparable to in-person care across a range of conditions and age groups, with good acceptability for patients and clinicians [35]. A larger review of the empirical evidence on telemedicine interventions in mental disorders extended this conclusion. It found consistent support for the effectiveness of telepsychiatric and telepsychological interventions, especially for depression, anxiety and post-traumatic stress, although the evidence was weaker for severe mental illness and for some settings [36]. For populations where mental health specialists are scarce and stigma discourages clinic attendance, these results are significant. The comparable-outcome finding means that telemedicine can extend access to specialist expertise without a loss in effectiveness.

4.2.5 Umbrella and technical reviews

A technical brief from a United States health-research agency mapped the evidence on telehealth from systematic reviews. It identified consistent evidence of benefit for remote patient monitoring in chronic conditions, and for communication and counselling interventions. It also identified significant evidence gaps for acute care and for many specialties, together with a lack of equity-focused analysis in the underlying reviews [37]. A more recent review of meta-analyses covering the decade to 2019 found that telehealth was at least as effective as comparator care for most conditions with adequate evidence, and superior for some, but that the quality of the meta-analyses was variable and that outcome reporting seldom disaggregated results by socio-economic subgroup [38].

4.2.6 Barriers to adoption

Review evidence on barriers is consistent. A worldwide systematic review of barriers to telemedicine adoption classified them as technological, financial, organisational, legal and attitudinal, and found that cost, infrastructure, resistance to change among clinicians and uncertainty around regulation recurred across settings [39]. A narrative review of capabilities, features and barriers reached a similar conclusion and added that data security, interoperability and the need for reliable connectivity are persistent limiting factors, especially in low-resource settings [40].

4.2.7 Equity and utilisation

Cohort-level evidence from the pandemic period provides a direct picture of inequity in utilisation. A study of ambulatory care at a large academic health system found that telemedicine access varied with patient characteristics, with lower use of video visits among older adults, lower-income groups and some minority and non-English-prefering populations [41]. A study of a large urban health system reported similar disparities, with differences by race and ethnicity, language and neighbourhood-level socio-economic indicators in who used telemedicine and through which modality [42]. These findings are crucial for the equity layer. They show that disparities in uptake arise even when telemedicine is offered universally, and that the least digitally connected are routed to lower-fidelity modalities such as audio-only visits.

4.2.8 Comparative matrix of related reviews

Table 2 consolidates the review-level evidence discussed above.

Table 2. Related research reviews: focus, evidence base, principal results and equity relevance

Ref.	Review focus	Evidence base	Principal results	Equity relevance
[29]	Effectiveness of telemedicine across applications (review of reviews)	Multiple systematic reviews	Benefit strongest for telemonitoring and psychiatry; primary evidence often insufficient or low quality	Calls for caution in generalising to disadvantaged groups; no equity analysis
[30]	Telemedicine for chronic disease management	Condition-by-condition synthesis of empirical studies	Effective or promising in many chronic conditions, especially monitoring-intensive ones	Relevant to populations with high chronic burden and limited specialist access
[31]	Interactive telemedicine (Cochrane)	Randomised trials	Modest glycaemic improvement in type 2 diabetes (about 0.3 points HbA1c); heart-failure outcomes comparable to usual care	Suggests parity of outcomes can be maintained when access is extended
[32]	Structured telephone support and	Randomised trials	Telemonitoring: lower all-cause mortality (about one fifth) and	Avoided admissions reduce cost exposure for remote and low-income patients

	telemonitoring in heart failure (Cochrane)		fewer heart-failure admissions (nearly 30%)	
[33]	Home telemonitoring in chronic disease	Systematic review across conditions	Improved blood pressure and glycaemic control; fewer heart-failure hospitalisations	Supports home-based monitoring where clinic access is limited
[34]	Patient satisfaction with telehealth	Systematic review and narrative analysis	High satisfaction; convenience and savings in travel and time	Satisfaction measured among users; non-users unrepresented
[35]	Effectiveness of telemental health	Review of mental-health applications	Outcomes comparable to in-person; good acceptability	Extends scarce specialist capacity to underserved areas
[36]	Telemedicine in mental disorders	Systematic review	Consistent support for effectiveness, strongest in depression, anxiety and PTSD	Reduces stigma and travel barriers; evidence weaker for severe illness
[37]	Telehealth outcomes mapped from systematic reviews	Technical brief	Benefit for remote monitoring in chronic disease; gaps in acute and specialty care	Identifies absence of equity-focused analysis
[38]	Clinical effectiveness of telehealth (review of meta-analyses, 2010–2019)	Meta-analyses	At least equivalent to comparator care for most conditions; variable quality	Subgroup outcomes by socio-economic status seldom reported
[39]	Worldwide barriers to adoption	Systematic review	Technological, financial, organisational, legal and attitudinal barriers	Cost and infrastructure barriers dominate in low-resource settings
[40]	Capabilities, features, barriers, applications	Narrative review	Security, interoperability and connectivity as persistent constraints	Connectivity gaps disproportionately affect underserved areas
[41]	Patient characteristics and telemedicine access	Cohort study (health system)	Lower video use in older, lower-income, some minority and non-English-preferring groups	Direct evidence of utilisation disparities
[42]	Telemedicine and disparities	Cohort study (urban health system)	Differences by race/ethnicity, language, neighbourhood income and modality	Shows audio-only fallback for the least connected

4.3 Evidence from the contextual corpus

The contextual works included in the review do not report randomised trial results. They contribute at the system, equity and technology-society levels, and are used here to interpret the effectiveness findings.

4.3.1 Digital innovation in diagnosis, engagement and operations

Work on artificial intelligence in diagnostic medicine examines how algorithmic tools are altering diagnostic pathways and what that implies for care in resource-constrained settings [43]. Complementary analysis of patient engagement in AI-driven systems considers how the design of digital interfaces shapes patient participation, trust and experience [44]. These perspectives are directly relevant to telemedicine, since remote care increasingly incorporates decision-support and triage tools. Analysis of hospital infection-prevention strategies [45] and of

evidence-based environmental design and educational interventions [46] provides a reminder that outcomes depend on the safety and quality of the physical and organisational environment into which remote care is integrated. Teleconsultation does not remove the need for safe downstream care when a patient must be referred or admitted.

4.3.2 Workforce, trauma and organisational culture

Trauma-informed approaches to healthcare leadership argue that organisational culture affects patient outcomes, particularly for patients with histories of adversity [47]. A systems-level analysis of burnout and bureaucracy among healthcare professionals highlights the workload and mental-health pressures on clinicians [48]. These topics bear on telemedicine in two ways. Virtual care can reduce or increase clinician workload depending on its design, and patients with trauma histories may find remote encounters either safer or more alienating, depending on how the encounter is conducted.

4.3.3 Crisis, displacement and vulnerability

Analysis of the health consequences of floods in Asian countries documents the direct and indirect effects of disasters on health systems, including damage to infrastructure and interruption of services [49]. A systematic review and meta-analysis on trauma-related mental-health outcomes among refugees and internally displaced persons in Africa documents high prevalence of psychological morbidity in conflict-affected populations [50]. A study of cancer-related stigma among tertiary students in Punjab shows how stigma shapes help-seeking behaviour in a regional context [51]. For these populations, which are disrupted, mobile, stigmatised or physically cut off, telemedicine is not a convenience but potentially the only functional route to continuity of care. They are also the groups for whom device access, connectivity and documentation are most precarious.

4.3.4 Data, analytics and facility management

Machine-learning approaches to smart facility management in healthcare environments [52] and AI-driven prediction of antimicrobial resistance patterns [53] illustrate how analytics are being integrated with health delivery. Their relevance to telemedicine lies in the data infrastructure that remote services share with these tools, and in the governance questions of consent, data quality and bias that arise when data from underserved populations are under-represented in training sets.

4.4 Cross-cutting synthesis of findings by research question

RQ1 (accessibility). Review-level and cohort evidence agree that telemedicine can improve geographic availability, reduce travel burden and expand access to specialist and mental-health expertise [31,35,36]. However, utilisation data show that access gains are unevenly captured, with lower use among older, lower-income, linguistically marginalised and digitally disadvantaged groups [41,42]. Accessibility is therefore improved at the level of the service and only conditionally at the level of the individual.

RQ2 (patient outcomes). Clinical outcomes are comparable to in-person care for many conditions and superior to usual care in some, notably heart failure, diabetes and common mental disorders [31,32,35,36]. Patient satisfaction is generally high [34]. Safety evidence is less developed, and evidence on outcomes disaggregated by socio-economic status is scarce [37,38].

RQ3 (determinants). The reviews converge on a set of determinants that apply across settings: infrastructure and connectivity, cost and reimbursement, clinician and organisational readiness, regulatory clarity, digital literacy and patient trust [39,40]. The contextual works add the roles of leadership, organisational learning and health legislation [18–21].

4.5 Comparative synthesis across perspectives

Table 3 compares the evidence from five perspectives on telemedicine for underserved populations. It summarises enablers, barriers and the implications that follow.

Table 3. Comparative synthesis of perspectives on telemedicine for underserved populations

Perspective	Principal enablers	Principal barriers	Representative evidence	Implication for design and policy
Patient and community	Reduced travel and time cost; privacy; convenience; reduced stigma in sensitive conditions	Lack of devices, connectivity and digital skills; language; limited private space; mistrust	[34,41,42]	Provide assisted-access points, multilingual and audio-capable options, and community digital navigators
Clinician and workforce	Extended reach; flexible scheduling; peer consultation	Lack of training; workload; loss of physical examination; burnout risk	[39,40,48]	Invest in training, workflow redesign and workload protection
Health system and organisation	Avoided admissions; efficient specialist use; continuity during crises	Infrastructure cost; interoperability; fragmented referral pathways	[18,20,21,32,33]	Integrate virtual care into referral networks and plan for downstream care
Policy and legal	Clear practice guidelines; reimbursement parity; data-protection rules	Regulatory uncertainty; licensure and liability gaps; weak enforcement	[12,19,39]	Create enabling and enforceable legal frameworks with equity safeguards
Technology and ethics	Decision support; remote monitoring; scalable platforms	Algorithmic bias; surveillance risk; data governance; digital exclusion	[11,43,44]	Embed equity audits, bias testing and privacy-by-design in platforms

5. Analytical Discussion

5.1 The central finding: effectiveness without equity is incomplete

The evidence reviewed supports two statements that appear contradictory but are in fact complementary. First, telemedicine is clinically effective across a wide range of conditions, and in several it improves on usual care. Second, telemedicine's benefits are unevenly accessed, and the people with the greatest need are often least likely to receive them. The first statement concerns the technology as tested in trials, where participants have been recruited, equipped and supported. The second concerns the technology as implemented in real systems, where uptake depends on the characteristics of populations and services. Reconciling these two statements is the main analytical task of the review.

The reconciliation is that the efficacy of telemedicine is conditional on access to telemedicine. A telemonitoring programme that lowers heart-failure admissions by nearly 30% in trial participants [32] cannot produce that benefit for a patient who has no device, no reliable connection or no way of interpreting what the device shows. Average effects reported in reviews therefore overstate the benefit available to populations that are structurally excluded from participation. This is a generalisability problem and an equity problem at once. It also explains why reviews of reviews find little equity-disaggregated analysis [37,38]. The studies that feed them enrolled participants who were, by design, able to take part.

5.2 The access displacement principle

The evidence supports a proposition that this review offers for citation and further testing: **telemedicine does not abolish access barriers; it displaces them.** Distance and travel cost are reduced, but new barriers arise in the digital domain (devices, bandwidth, interface literacy), the institutional domain (registration, documentation, platform design, payment), and the social domain (privacy, trust, gendered control of devices). Barriers are not eliminated but moved from the geographic domain into domains where disadvantaged groups may be equally or more constrained.

This principle explains the pattern in the cohort data. When telemedicine is offered to everyone, differences in use follow the lines of age, income, language and ethnicity [41,42]. It is consistent with warnings that informatics interventions can worsen inequality if they are first adopted by those who already have the most resources [11],

and with pandemic-era analyses of how the digital divide determined participation [10]. It is also consistent with the logic of the access frameworks used here. Access is realised at the meeting of services and abilities [14], and telemedicine alters the abilities required without necessarily supplying them.

5.3 Patient perspective: convenience, dignity and exclusion

From the patient perspective, telemedicine offers savings in travel time and cost, privacy, and, for stigmatised conditions, the possibility of seeking care without being seen entering a clinic. The satisfaction evidence is consistently positive [34]. The mental-health literature is particularly encouraging, because outcomes are comparable to in-person care while barriers of distance and stigma are reduced [35,36]. In contexts where stigma shapes help-seeking, as the study of cancer-related stigma in Punjab illustrates [51], the privacy afforded by remote consultation may be a genuine enabler.

The same patient perspective also reveals exclusion. A patient who cannot use video must accept audio-only or no care, and the evidence suggests that audio-only use is concentrated in disadvantaged groups [42]. Audio-only care is better than none, but it limits visual assessment and can reduce quality. For women who share devices or lack control over them, and for people with limited literacy or disability, interface design may be an insuperable barrier. Conversely, digital technologies carry their own risks for wellbeing. Research on compulsive digital engagement among adolescents, for example, points to the neuropsychological pressures of heavy screen use [61], and work on digital minimalism explores deliberate resistance to constant connectivity [63]. These findings do not weaken the case for telemedicine, but they caution against treating more digital contact as automatically beneficial. Care should be delivered through the minimum digital interaction that meets clinical need.

5.4 Clinician and workforce perspective

Clinicians report that telemedicine extends their reach and enables peer consultation, but barrier reviews consistently cite lack of training, workflow disruption and resistance to change [39,40]. Concerns about the loss of physical examination are legitimate for some specialties. The workforce dimension is intertwined with wellbeing. A systems-level analysis of burnout among healthcare professionals points to administrative burden and structural pressure as key drivers [48]. If telemedicine is added on top of existing duties without redesign of workload, it may intensify the problem. If it is integrated with scheduling flexibility, reduced travel and appropriate support, it may relieve it. Leadership is a decisive variable here, as research on hospital leadership styles suggests [20], and organisational learning from pandemic experience can help embed lessons [21].

5.5 Health-system perspective: integration, safety and resilience

At the system level, telemedicine's value depends on integration. A remote consultation that identifies a need for investigation, treatment or admission is useful only if the downstream pathway exists. The importance of safe downstream care is underlined by analyses of hospital infection prevention [45] and of environmental design and educational interventions in healthcare [46]. A system that expands front-end access without strengthening the quality of what lies behind it may simply move delays and risks further along the care pathway.

Resilience is an equally important system function. Analyses of floods and their health consequences show how disasters disrupt facilities, transport and supply chains [49], and the evidence on conflict-affected and displaced populations shows the scale of unmet mental-health need [50]. Climate-related displacement creates new populations with fragmented access to continuing care [62]. In these situations, telemedicine can preserve continuity of prescriptions, follow-up and psychological support when physical access fails. Its disaster value, however, depends on infrastructure that is itself vulnerable to the same disasters. Planning for telemedicine as a resilience tool therefore requires offline-capable systems, redundant connectivity and pre-agreed protocols.

Digital transformation more broadly can improve hospital management, but evidence and analysis stress that benefits depend on workforce capacity, governance and organisational readiness [18]. The use of machine learning for facility management [52] and for surveillance of antimicrobial resistance [53] shows the direction of travel, in which telemedicine will increasingly be one component of a data-rich, algorithmically assisted system. This raises the stakes of data governance.

5.6 Policy and legal perspective

Legal and regulatory clarity is a recurring determinant in barrier reviews [39]. India's telemedicine practice guidelines illustrate a regulatory response. They define who may practise, how consent and records are handled, and what professional responsibilities apply [12]. Policy-legal analysis of health legislation argues that statutory frameworks are central to health-system strengthening, because they create the conditions for accountability, financing and quality [19]. Regional socio-legal analysis of health disparities in Punjab similarly argues that legislative gaps and structural inequities shape who receives care, and that equitable pathways require legal as well as clinical reform [8]. The same logic extends beyond health. Socio-legal analysis of educational disparities shows how structural inequities persist even where formal frameworks exist, because implementation and awareness are uneven [58]. The parallel for telemedicine is direct. A well-drafted guideline does not guarantee equitable practice if awareness, enforcement, reimbursement and infrastructure are weak.

Several legal questions merit attention. Licensure across jurisdictions, liability for remote misdiagnosis, consent in low-literacy settings, the status of audio-only consultations, and data-protection obligations are all areas where law is evolving. For underserved populations, the risk is twofold. Ambiguity can discourage providers from offering services, and weak protections can expose vulnerable patients to data misuse.

5.7 Technology, ethics and society

The digital society literature supplies a set of warnings that apply directly to telemedicine. Analyses of algorithmic bias show how AI systems can reproduce and amplify social stratification when training data and design choices reflect existing inequalities [54]. Applied to telemedicine, this means that triage algorithms, symptom checkers and diagnostic aids developed on non-representative data may perform worse for the populations that most need them. The work on artificial intelligence in diagnostics [43] and on patient engagement in AI-driven systems [44] suggests the potential, but also the need for validation across diverse groups and for interface designs that build, not erode, trust.

Spatial and urban analyses of smart-city technologies argue that digital infrastructure investment can deepen spatial injustice when benefits cluster in already advantaged areas [55]. A study of digital displacement in technology-driven urban change makes a related argument about how technology hubs reshape community belonging and who is included [59]. The lesson for telemedicine is that infrastructure rollout is not neutral. Where broadband, devices and support concentrate in affluent districts, virtual care follows them.

Work on platform poverty and algorithmic invisibility among gig workers identifies a form of exclusion in which people become invisible to, or disadvantaged by, digital platforms [56]. Underserved patients may similarly become invisible to digital health systems that measure only those who log in. This is the data-side counterpart of the satisfaction bias noted earlier. Meanwhile, analysis of digital surveillance and sovereignty in the Global South raises concerns about the use of digital infrastructure for monitoring and control [57]. For telemedicine, which generates sensitive health data, the implications for privacy, consent and state or corporate access are serious, and they bear most heavily on groups with least power to contest data practices.

Finally, studies of post-pandemic changes in relationships and family life remind us that the hybrid mode of living has reshaped intimacy and care [60]. Hybrid care may be integrated naturally into everyday life for some households, while for others the shared device, crowded home or lack of privacy makes confidential consultation difficult.

5.8 Comparative reading of effectiveness and equity evidence

A comparison of the effectiveness reviews (Table 2) with the equity and contextual evidence (Table 3) reveals a structural asymmetry. Effectiveness evidence is quantitative, trial-based and condition-specific. Equity evidence is observational, descriptive and system-level. Effectiveness reviews report outcomes among participants. Equity studies report utilisation among eligible populations. The two evidence streams are rarely linked, so no review in the corpus reports both the effect of telemedicine on outcomes and the distribution of that effect across socio-economic groups. This is the most important evidence gap. It means that claims about telemedicine's impact on underserved populations must currently be assembled by inference from separate bodies of evidence, and not read from a single study.

A second asymmetry concerns modality. The effectiveness evidence is dominated by telemonitoring, structured telephone support and video consultation [31–33,35,36]. The equity evidence suggests that underserved groups may be disproportionately routed to audio-only contact [42]. Where telephone support has demonstrated benefit, as in heart failure [32], this is not necessarily a disadvantage. Where visual assessment is essential, it is. The evidence therefore supports a modality-matching approach in which the mode of contact is selected on clinical need and patient capability, and not on administrative convenience.

A third asymmetry concerns setting. Reviews are drawn largely from high-income systems with established infrastructure. For India and comparable settings, where disease burden is large and changing [6,7] and regional inequities are marked [8], the transferability of these results depends on the very infrastructure, workforce and legal conditions that telemedicine is meant to compensate for. Direct digital-equity analysis in the Indian context [9] is therefore valuable, but it must be accompanied by empirical outcome studies that remain scarce.

5.9 Propositions for citation and further testing

The analysis yields five propositions, offered as hypotheses that future research can test.

- **Access displacement.** Telemedicine reduces geographic barriers while relocating barriers to digital, institutional and social domains; net access gain for a group equals the geographic barrier removed minus the new barriers introduced.
- **Conditional efficacy.** The efficacy shown in trials applies only to those who can participate; population-level effectiveness is the product of efficacy and effective reach.
- **Modality stratification.** In the absence of deliberate design, the least advantaged are routed to the least resource-intensive modality, which may be the least clinically adequate for some conditions.
- **Invisible non-users.** Satisfaction and utilisation data systematically under-represent those excluded from digital services, producing optimistic estimates of impact.
- **Equity by design.** Equitable outcomes require equity-specific features built into service design (assisted access, multilingual interfaces, offline fallback, and disaggregated monitoring), because equity does not emerge reliably from universal availability.

6. Implications

6.1 Implications for policy

Policy should treat digital connectivity and digital literacy as determinants of health, and should fund assisted-access models such as community health-worker-supported or facility-based telemedicine points so that individual device ownership does not become a precondition for care. Regulation should be clear on licensure, consent, liability and data protection, and it should explicitly address audio-only and asynchronous modalities, which matter most to the least connected [12,19]. Reimbursement should not penalise lower-bandwidth modalities where they are clinically appropriate. Equity metrics should be required in programme monitoring, so that utilisation and outcomes are routinely reported by income, geography, gender, age and language.

6.2 Implications for health-system management

Managers should plan telemedicine as an integrated pathway and not a stand-alone service. That requires clear referral routes, medicines supply, diagnostics and follow-up. Digital transformation should be accompanied by workflow redesign and workforce training [18]. Leadership attention to clinician wellbeing and to organisational learning should be built into implementation [20,21,48]. Disaster-resilience planning should include telemedicine continuity protocols for flood-prone, conflict-affected and displaced populations [49,50,62].

6.3 Implications for clinical practice

Clinicians should select modality by clinical need and patient capability, offer in-person care when examination is essential, and use trauma-informed communication where patients have histories of adversity [47]. Clear safety-netting advice should be given because remote assessment can miss deterioration. Clinicians should also be alert to the risk that patients who do not attend virtual appointments may be those with the greatest barriers and not those with the least need.

6.4 Implications for technology developers

Developers should test tools across diverse populations, publish performance by subgroup, audit for algorithmic bias [54], and design for low-bandwidth, low-literacy and shared-device contexts. Privacy-by-design and limits on data re-use are essential, given the surveillance risks that digital infrastructure can present [57].

6.5 Research agenda

Priority areas are as follows. Trials and quasi-experimental evaluations should report outcomes disaggregated by socio-economic status, geography and digital capability. Studies from South Asia, sub-Saharan Africa and other under-represented regions are needed. Research should evaluate assisted-access and hybrid models, and should compare audio-only, video and asynchronous modalities for equity-relevant outcomes. Economic evaluations should include the patient's perspective, counting travel, lost wages and out-of-pocket costs. Finally, qualitative work with non-users should address the invisible-non-user problem.

7. Limitations

Several limitations should be acknowledged. First, the review was not prospectively registered, and the information sources were an author-curated corpus plus a targeted supplementary retrieval, not an exhaustive multi-database search. The selection may therefore reflect the interests and networks of the research team, and relevant studies may have been missed. The replication protocol in Section 3.3 is offered to allow this limitation to be addressed in later work.

Second, a substantial share of the contextual works in the corpus share authorship. This concentration carries a risk of citation insularity, in which a limited set of perspectives is over-represented. These works were used for context and interpretation and not as primary effectiveness evidence, and the quantitative claims in this review rest on the independent review-level syntheses. Readers should nonetheless weigh the contextual material with this concentration in mind, and future work should diversify the contextual base.

Third, the contextual works are heterogeneous in design and rigour, and many are analytical or conceptual and not empirical. They inform interpretation but cannot establish causal effects. Fourth, the review-level evidence is geographically concentrated in high-income settings, which limits transferability. Fifth, effectiveness reviews seldom disaggregate outcomes by socio-economic status, so the distributional claims in this review are necessarily inferential. Sixth, narrative synthesis, though appropriate to the heterogeneity of the evidence, is vulnerable to subjectivity, and no pooled effect estimate is offered. Finally, the pandemic-period cohort evidence on utilisation reflects an emergency context, and patterns may differ in stable conditions.

8. CONCLUSION

Telemedicine can extend healthcare to people whom distance, cost and scarcity of specialists have long excluded. Review-level evidence indicates that, for many conditions, outcomes match or exceed those of usual care, and that patients are generally satisfied. Where heart failure, diabetes and common mental disorders are concerned, the gains can be substantial. These findings justify continued investment.

They do not justify complacency about equity. The same evidence base shows that those who are older, poorer, rural, linguistically marginalised or digitally unconnected use virtual care less, and that satisfaction and outcome data are collected mostly from people who could participate. Telemedicine reconfigures barriers and does not remove them, which is the sense of the access displacement principle proposed here. Whether this reconfiguration helps or harms underserved populations depends on deliberate choices about infrastructure, modality, regulation, workforce, data governance and monitoring.

The practical conclusion is that universal availability is not equivalent to equitable access. Equity must be designed, measured and enforced. Services that pair clinically sound telemedicine with assisted-access models, multilingual and low-bandwidth options, strong legal safeguards and disaggregated monitoring have the best prospect of turning the technology's promise into measurable improvement in the health of those most in need. The research agenda that follows is clear: evidence that links outcomes to distribution, collected in the settings where the need is greatest.

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