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Research article

Telemedicine as a substitute for in-person primary care: Scenarios and boundaries

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Abstract: Background: Telemedicine has become a routine part of primary care, but its relationship with in-person care remains uneven. The question is not simply whether remote care works; it is which parts of primary care can be moved into remote channels and which parts still need face-to-face contact.

Methods: This review examined a corpus of 149 studies and organized the evidence around chronic disease management, mental and behavioral health, triage and resource allocation, and care for marginalized or hard-to-reach populations.

Results: The clearest support was found for stable follow-up, prescription renewal, routine monitoring, selected behavioral interventions, and some standardized screening or triage tasks. The limits are just as visible. First-contact diagnoses, emergencies, complex multi-morbidities, physical examinations, procedures that require touch or equipment, and encounters that depend heavily on trust and non-verbal communication remain difficult to substitute.

Conclusion: A cautious conclusion follows: telemedicine can replace selected tasks and encounters, but not the clinical, relational, and procedural role of in-person primary care as a whole.

Keywords: telemedicine; in-person care; primary care; substitution effect; evidence synthesis

Notations and abbreviations.

AI	artificial intelligence
eConsult	electronic consultation
INTRePID	International Consortium of Primary Care Big Data Researchers
NASSS	Nonadoption, Abandonment, Scale-Up, Spread, and Sustainability
PrEP	pre-exposure prophylaxis
COVID-19	coronavirus disease 2019
FQHC	Federally Qualified Health Center
MOUD	medications for opioid use disorder
OUD	opioid use disorder
WHO	World Health Organization

1. Introduction

In primary care, the default has long been face-to-face contact. That default is not accidental. Primary care brings together first-contact assessments, continuity, chronic disease management, preventive care, and referral coordination, and the World Health Organization (WHO) health system framework places these functions within the wider work of strengthening service delivery and universal coverage [1]. Many of these tasks still rely on clinical examinations, accumulated knowledge of the patient, and relational trust built over time. Now, the question is why this default is being reopened. Population ageing, chronic illnesses, workforce shortages, rising costs, and uneven access to appointments have made routine in-person visits harder to treat as the only normal form of primary care.

This pressure was visible before COVID-19, although the pandemic made it impossible to ignore. Ganguli et al. [2] described a decline in primary care visit volume in the United States. During the pandemic, digital communication, video visits, telephone consultations, and asynchronous messaging moved quickly into primary care workflows. The scale of this shift was substantial. In the INTRePID consortium's comparative analysis of more than 80 million primary care visits across nine countries, Tu et al. [3] showed that in-person visits generally declined after the pandemic began, with virtual visits partly offsetting that decline in some countries. In Ontario, Canada, Glazier et al. [4] recorded a 79.1% decline in in-person primary care visits from March to July 2020 compared with the same period in 2019, while virtual visits accounted for 71.1% of primary care visits. However, uptake is not the same as substitution. These figures show that remote care entered routine practice quickly; they do not show whether it replaced face-to-face care, merely supplemented it, or formed part of a hybrid model.

Much of the literature still approaches telemedicine through a broader question: does it work? That is too broad for the problem considered here. Evidence on effectiveness, access, utilization, patient experience, and satisfaction is useful, but it leaves the substitution boundary partly unresolved. Some reviews support remote delivery for stable chronic disease management and routine follow-up. Mabeza et al. [5] found that, for instance, synchronous telemedicine was improved or non-inferior to in-person care for diabetes, hypertension, and hyperlipidemia outcomes. Bracken et al. [6] additionally reported that physician-led synchronous telemedicine in primary care was associated with similar or lower levels of some forms of healthcare system use, while noting the limits created by selection bias, confounding, and generalizability. The cautionary evidence matters just as much. Payne et al. [7] showed that contemporary hybrid general practice can compromise patient-centeredness, equity,

continuity, and the human elements of care, and Valdes et al. [8] found that telemedicine sustainability depends on patient experience, health inequalities, and clinician-patient relationships. Thus, the harder issue is not whether telemedicine can be useful in primary care; it is where its substitutive use begins to break down.

This review takes that boundary as its object. It does not assume that every remote encounter is either a full replacement for, or merely an addition to, in-person care. Instead, it asks which service scenarios, patient groups, clinical tasks, and system conditions allow remote care to replace some face-to-face encounters without treating in-person primary care as dispensable. The objective is to synthesize evidence on three linked issues: when telemedicine can substitute for in-person primary care, what conditions make that substitution plausible, and where the limits appear. Those limits include diagnostic uncertainty, physical examination, clinical complexity, trust, and digital exclusion. Particular attention is given to routine and chronic disease management, mental and behavioral health, triage and resource allocation, and care for special or hard-to-reach populations.

2. Literature sources and review methods

2.1. Terminology

The terms telemedicine, telehealth, virtual care, and remote care are treated in this review as overlapping labels, not as identical domains. In the studies reviewed here, they refer to clinical primary-care contact delivered at a distance through telephone, video consultation, online messaging, asynchronous consultation, or other internet-enabled communication tools. We do not use them as a general synonym for all digital health. The narrower concern is the relationship between remote primary care and in-person care: when, and under what conditions, can a remote encounter take the place of a visit that would otherwise happen face to face? In this paper, substitution means that remote care replaces an in-person encounter. Complementarity means that remote care supports face-to-face care without replacing it. Synergy refers to the coordinated use of remote and in-person care within the same care pathway. The distinction matters because an online contact may change a pathway without actually substituting for a visit.

2.2. Literature search strategy

The search was intentionally wider than the final review question. That choice matters. Telemedicine substitution in primary care sits next to several neighboring topics: digital health, artificial intelligence, online health information, doctor-patient trust, therapeutic relationships, adherence, and chronic disease management. Therefore, we used the initial search to capture a broad primary-care digital health corpus, and then narrowed that corpus during screening and coding. The database was the Web of Science Core Collection, and the publication window ran from January 2000 to April 2026.

The search string was kept as follows: TS=(("primary care" OR "general practice" OR "family physician*" OR "community health service*") AND ("artificial intelligence" OR AI OR "digital health" OR e-health OR "online health information" OR "clinical decision support") AND (trust OR "patient trust" OR "physician trust" OR "doctor-patient relationship" OR "therapeutic relationship") AND (adherence OR compliance OR "chronic disease" OR diabetes OR hypertension)) AND

TS=(trust OR "doctor-patient relationship" OR "patient-physician relationship" OR "digital health" OR e-health OR "artificial intelligence" OR "online health communities").

This broad search produced more material than the substitution question finally required. The real narrowing happened later, at screening and coding. We retained studies only when they spoke directly to internet-enabled primary care, remote consultation, virtual care, or the relationship between digital and in-person primary care. Reference lists of included full-text articles were checked as well, and selected grey literature sources were searched for additional relevant records.

2.3. Study selection

The search returned 576 records. After 131 duplicates were removed, 445 records remained for title and abstract screening. At this stage, 101 records were excluded: 95 were outside the primary care setting, and 6 did not involve a relevant digital or internet-enabled intervention. The remaining 344 articles were assessed in full text. Of these, 202 were excluded. More specifically, 124 did not address offline or in-person medical services, and 78 did not discuss service relationship effects, such as the relationship between remote care and face-to-face care, doctor-patient interaction, service substitution, complementarity, or related service effects. Full-text review retained 142 studies. Reference-list searches added 5 studies, and targeted grey literature searches added 2, resulting in a final corpus of 149 studies. Figure 1 summarizes this selection process.

Eligibility was defined around setting, intervention, service relationship, and evidence type. Studies were included when they focused on primary care, general practice, family medicine, or community-based first-contact care; examined telemedicine, virtual care, remote consultation, or another internet-enabled care model; addressed the relationship between remote care and in-person care; and provided empirical evidence, review evidence, implementation evidence, or policy-relevant evidence. Studies were excluded when they were outside primary care, focused only on hospital-based specialist telemedicine, described technical development without service or clinical evidence, did not discuss the relationship between remote and in-person care, or offered only general commentary without substantive evidence.

2.4. Data extraction and coding

For each included study, we extracted publication year, country or region, study design, care setting, patient group, type of digital or remote-care technology, service scenario, comparator, main outcomes, and relevance to substitution. The coding was guided by a practical question: when can internet-enabled care replace part of face-to-face primary care, and where does that replacement stop? Particular attention was given to whether telemedicine functioned as a full substitute for in-person care, a partial substitute, or a complement to face-to-face consultation. Additionally, we recorded the clinical and organizational conditions that shaped substitution, including disease stability, need for physical examination, diagnostic uncertainty, patient digital access, continuity of care, clinician workload, and service integration.

Tasks that could be moved online were coded separately from services that could only be partly substituted. Situations that still required in-person care were also marked out. This distinction allowed the review to separate evidence of general telemedicine effectiveness from evidence of actual substitution.

2.5. Analytical method

The synthesis was narrative and scoping-style, with thematic synthesis used to organize the evidence. It was not a meta-analysis. Moreover, it was not a registered systematic review or a certainty-rating exercise. Figure 1 records how the literature was selected; the analysis does something more interpretive. The final corpus informed the themes, while the manuscript cites the core studies most directly used to support the main arguments. The guiding question was simple enough, but not easy to answer: across clinical scenarios, service settings, and boundary conditions, where does telemedicine actually become a substitute for in-person primary care?

We grouped the evidence into four thematic areas: routine and chronic disease management, mental and behavioral health interventions, triage and resource allocation, and care for special settings or marginalized populations. Reviews, meta-analyses, and large real-world studies carried the broader pattern work. Observational, implementation, and qualitative studies were used differently: they helped interpret mechanisms, context, patient experience, and service conditions. Study protocols were kept in view, but only cautiously, as signs of emerging research rather than evidence of established effects. The synthesis kept returning to three questions: where telemedicine appears substitutable, where it is only partly substitutable, and where in-person primary care still has to carry the work. The evidence profile is summarized in Table 1.

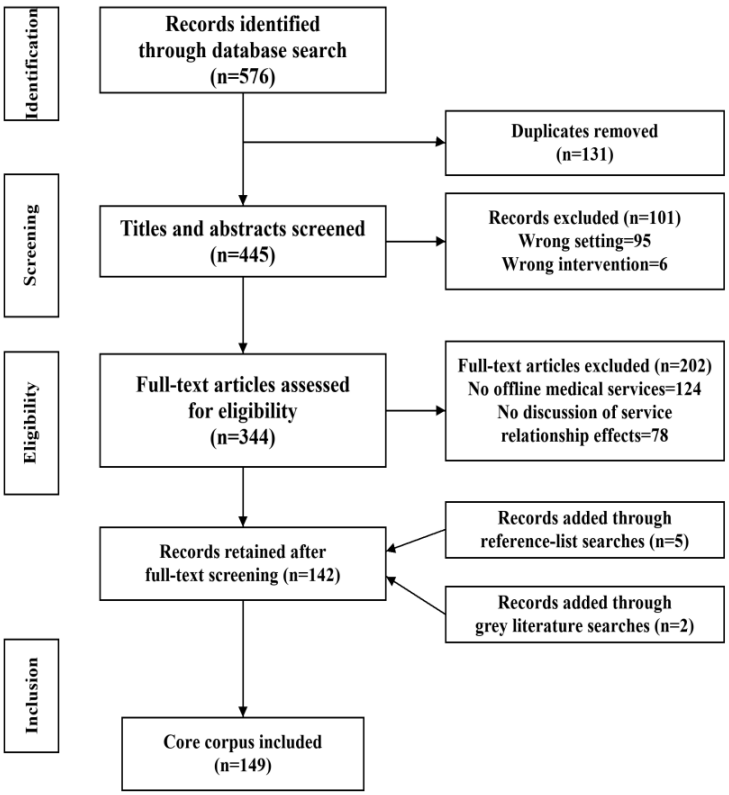

Figure 1. Literature screening flow diagram.

Table 1. Evidence profile for telemedicine substitution in primary care.

Service context	Representative evidence	Substitution judgement	Boundary and interpretation
Routine and chronic disease management	Systematic reviews, meta-analyses, and remote-monitoring evidence, including Mabeza et al. [5], Zhang A et al. [9], Bracken et al. [6], and Persell et al. [10].	Strongest support for limited substitution in stable follow-up, routine monitoring, prescription renewal, and clearly defined chronic disease tasks.	Substitution is weakest at first diagnosis, acute deterioration, complex multi-morbidities, or any encounter requiring physical examination. This is the clearest area of consensus, but only for selected tasks.
Mental and behavioural health	Pandemic service-use studies, behavioural health transition studies, and integrated-care evidence, including Silva-Valencia et al. [11], Rene et al. [12], and Haderlein et al. [13].	Moderate to high potential for counselling, follow-up, and remote specialty support when the encounter is communication-based and risk is stable.	Crisis assessment, self-harm risk, severe psychiatric symptoms, and early relationship-building require stronger in-person or hybrid safeguards. Evidence is promising but more context-dependent.
Triage hubs and resource allocation	Capacity estimates and referral-workflow studies, including Jetty et al. [14], Liddy et al. [15], and Livingstone and Solomon [16].	Moderate support for routing demand, avoiding some unnecessary referrals, and supporting standardized screening or triage tasks.	Telemedicine substitutes selected service links rather than full care pathways. Its value depends on triage accuracy, information completeness, specialist feedback, and follow-up arrangements.
Special settings and marginalised groups	Pandemic and access-related studies, including Tu et al. [3], Glazier et al. [4], Hser et al. [17], Ober et al. [18], and Srinivasulu et al. [19].	Context-dependent potential to reduce distance, privacy, stigma, or service-entry barriers.	The same model may reduce or reproduce inequity depending on digital access, language, disability, trust, local staffing, and navigation support. This is an equity-sensitive area rather than a simple access gain.
High-risk diagnostic or procedural care	Patient-safety, communication, and procedure-related evidence, including Payne et al. [20], Payne et al. [7], Selick et al. [21], and Kornelsen et al. [22].	Low substitution potential. Remote care may support preliminary contact, follow-up, or information exchange but should not replace in-person assessment when risk is high.	Emergencies, ambiguous symptoms, complex multi-morbidities, palpation, bedside examination, point-of-care procedures, and relationship-sensitive encounters mark the clearest limits of substitution.

The results are read from two angles: historically, how telemedicine came to take on a substitutive role in primary care; and practically, in which clinical or service situations that substitution appears plausible. The evidence does not support a simple replacement story. Instead, it points to a more limited claim: substitution depends on task, setting, patient group, and system support.

3. Evolution of telemedicine's substitution role

Chronologically speaking, the 149 studies do not tell one even story; they fall into three phases: pre-pandemic pilot use, COVID-19 emergency substitution, and post-pandemic integration into hybrid care. That sequencing matters. As the service environment changed, telemedicine changed with it: first it was a supplementary tool near the margins of primary care, then an emergency substitute, and later one part of routine service redesign rather than a stand-alone replacement for the clinic.

Before 2020, telemedicine was still near the edge of primary care rather than at its center. The 31 studies from this period mostly describe feasibility testing and supplementary use. Routine substitution is rare. Early work asked whether clinicians and patients would accept eHealth at all; for example, Richards et al. [23] showed that adoption was shaped by geography, workflow, user habits, and system convenience. Other studies in this period examined remote specialty support, chronic disease tools, and small-scale digital health pilots. The pattern is not hard to read. Telemedicine helped particular collaborations and follow-up tasks, but it did not yet reorganize primary care itself.

COVID-19 changed the function of telemedicine quickly. In the 48 studies from this period, remote care appears less like an optional supplement and more like an emergency substitute for in-person contact. The visit data show the shift most clearly: in Ontario, Canada, Glazier et al. [4] documented the abrupt movement from office-based to virtual primary care, Singer et al. [24] recorded large-scale virtual visit use in a retrospective cohort in Manitoba, and Schweiberger et al. [25] provided snapshot evidence from a pediatric primary care network in the United States. Capacity estimates point in the same direction. Using the U.S. National Ambulatory Medical Care Survey, Jetty et al. [14] estimated that a substantial share of primary care visits and services could be delivered remotely. Ward et al. [26] further summarized the range of telehealth visit types used in primary care during the pandemic. This was a forced expansion. It proved that large-scale substitution could happen under crisis conditions, but it did not prove that a stable model had already been built.

After the emergency period, the question changed again. The 70 studies from 2023 to April 2026 were less concerned with whether remote care can be delivered; they asked how hybrid care can be sustained. One strand follows what happened after virtual visit shares fell from their pandemic peak. Using claims data from Alberta, Canada, Fahim et al. [27] found that virtual visits declined from their highest pandemic levels but did not fully return to pre-pandemic patterns. In other words, telemedicine had moved from emergency substitution into a more normalized but still unsettled hybrid operation. Sustainability and governance then become central: Valdes et al. [8], using the NASSS framework, argued that telemedicine sustainability depends on alignment among technology, organizations, patients, value propositions, and institutional environments, while Srivastava et al. [28], through a five-country policy comparison, showed that institutional arrangements shape virtual primary care pathways. Expansion was no longer the hard question: quality control, institutional integration, and routine hybrid operation were.

4. Applicable scenarios for telemedicine substitution

4.1. Routine and chronic disease management

A routine follow-up is the easiest part of chronic disease care to defend remotely. The work is usually already known: monitoring, medication review, self-management support, or discussion of test results. That makes a real difference. A planned blood pressure review or medication check, where the patient history, prior results, and care goal are already on the table, is not the same clinical event as first diagnosis, nor is it the same as an examination that depends on touch, observation, or immediate clinical judgment.

Completed reviews give the strongest support for this narrower claim. By reviewing seven studies, Mabeza et al. [5] found that synchronous telemedicine produced outcomes similar to in-person visits for diabetes, hypertension, and hyperlipidemia. Zhang A et al. [9] added meta-analytic evidence on glycemic control in type 2 diabetes. Persell et al. [10] gave a more practical example of remote patient monitoring for hypertension in primary care. Thus, the claim should stay narrow: substitution looks plausible when indicators can be monitored remotely and the goals of care are already clear. First visits, emergencies, and complex cases that need examination are a different matter.

Remote care also has a place in common disease consultation, prescription renewal, and selected image-based services. The fit is uneven. Downes et al. [29] provided systematic-review evidence on telephone consultations in general practice, while Nijhof et al. [30] showed how online consultations can be embedded in primary care services in the East Midlands. Prescribing evidence is more concrete: Avdic et al. [31] found that Australian primary care physicians with higher telemedicine adoption prescribed fewer antibiotics, while prescribing quality appeared unaffected. Image-based primary care offers another partial substitution pathway; Livingstone and Solomon [16] found evidence supporting the cost-effectiveness, safety, and patient satisfaction of a general practice teledermatology service. Older adults and cognitive impairment make the boundary more visible. Ilali et al. [32] provided summary evidence through a mixed systematic review, and Klinton et al. [33] documented the difficulties caregivers of patients with dementia face in remote primary care.

4.2. Mental and behavioral interventions

Mental and behavioral health does not behave like chronic disease monitoring. Some encounters are mostly communicative and follow-up based, which means remote contact can replace part of the visit. Others are much harder to move. When crisis identification, privacy, therapeutic relationship, and continuity are central to the encounter, the medium is no longer a minor delivery detail.

The pandemic evidence first shows a change in visit mode. Using a nine-country interrupted time-series design, Silva-Valencia et al. [11] documented movement toward remote primary mental health visits during the pandemic. Rene et al. [12] described the shift from in-person to remote behavioral health in primary care. Haderlein et al. [13] moreover suggested that virtual care can support same-day access within integrated primary care mental health services, which is useful evidence, but only up to a point. It supports selective substitution when the work is communication-centered and follow-up oriented; it is weaker when risk assessment or the therapeutic relationship carries most of the clinical weight.

Opioid use disorder (OUD) and substance use services need a separate reading. Telemedicine may

widen access, but the evidence is not all of the same strength. Hser et al. [17] and Ober et al. [18] provided the more direct empirical support. Hser et al. examined a coordinated rural primary care model in which a primary care physician worked with an external remote medications for opioid use disorder (MOUD) provider, while Ober et al. analyzed implementation conditions for the same referral and coordination model from multiple stakeholder perspectives. Virtual MOUD may reach people who are poorly served by in-person systems. The harder question is what happens over time: effectiveness, continuity, and equity are still less certain.

4.3. Triage hubs and resource allocation

Telemedicine can also work as a triage and resource-allocation tool. Here, the value is not that every remote contact replaces a visit. It is more practical than that: remote contact can help primary care systems sort which patients can be managed remotely, which need in-person assessment, and which should be referred urgently.

For triage hubs and resource allocation, the evidence starts with service capacity rather than individual clinical outcomes. Through trends in pediatric primary care visits, Ray et al. [34] showed that primary care demand was changing. Jetty et al. [14] estimated that approximately 42% of U.S. primary care visits are suitable for telehealth and that 73% of services can be provided remotely. These figures need a careful reading. They estimate what could in principle be delivered remotely; they do not prove that safe substitution has already occurred. Nevertheless, the estimates give a supply-side basis for asking which services might move into remote channels. The claim should remain cautious: remote models can help triage demand and expand standardized intervention pathways, while completed trials and real-world outcomes are still needed.

4.4. Special environments and marginalized groups

For geographically isolated, mobility-limited, or otherwise underserved populations, telemedicine may reduce travel burden and improve access to primary care. That does not make substitution automatic. Its value depends heavily on digital access, local support, and the availability of in-person care when remote contact is not enough.

The pandemic provides the clearest evidence of rapid service conversion. At the multi-country level, Tu et al.'s [3] INTRePID study covered approximately 80 million primary care visits across nine countries and showed declining in-person visits alongside compensatory virtual visits under pandemic shock. Regional and single-country data point in the same direction. Glazier et al. [4], Singer et al. [24], and Schweiberger et al. [25] recorded sharp increases in virtual visits in Ontario, Canada, Manitoba, Canada, and a U.S. pediatric primary care network, respectively. Ward et al. [26] summarized multiple telehealth visit types during the pandemic. This evidence is strong on rapid conversion and weaker on durability. Remote care could absorb part of the pandemic shock, but the evidence does not by itself settle whether emergency substitution should become routine practice.

Women's and sexual health point to a different tension: access and privacy may improve, while relationship quality may suffer. By examining women's preferences for remote sexual health consultation in New York, Srinivasulu et al. [19] showed that some patients neither need nor want an in-person visit every time. However, Zhang C et al. [35] cautioned that in pre-exposure prophylaxis (PrEP) care, remote models may lower access barriers while weakening empathy, connection, and

perceived service quality. The evidence does not show that remote services are superior to in-person visits. It shows why some patients may prefer remote contact for sensitive services, and why clinical teams still need to protect continuity, trust, and communication quality.

5. Factors shaping telemedicine's substitution effect

Clinical feasibility alone does not decide telemedicine substitution: fit does. The patient has to fit the technology, the task has to fit the medium, the clinician has to fit the workflow, and the institution has to have the payment and infrastructure conditions to support the encounter. Missing one of those pieces can make the same remote model much less substitutable.

Patient characteristics complicate any simple claim about substitution. The evidence does not point in only one direction. Using data from FQHCs in Texas, Adepoju et al. [36] found lower telehealth use among Hispanic and uninsured residents, although use was higher among residents of metropolitan and medically underserved areas. Sierra-Heredia et al. [37] reported related inequities among older immigrants as services returned toward in-person care. Special populations make the point sharper: Ohl et al. [38] focused on geographic access for HIV patients, while Selick et al. [21] identified communication barriers in virtual primary care for people with intellectual and developmental disabilities. Telemedicine may compensate for weak in-person access in one setting and reproduce exclusion in another. Much depends on population, region, and support conditions.

The digital divide runs through both sides of the encounter. For patients, Tuan et al.'s [39] study of patient portal use points to practical constraints around access, digital skills, and engagement with online systems. These are not small details. On the service side, Blake et al. [40] showed uneven digital maturity among Australian general practices. Therefore, the divide is not just about whether a patient can use a mobile phone; it is a combined problem of patient capacity, institutional maturity, and service workflow.

The clinical task matters as much as the disease label. In chronic disease follow-up, synchronous telemedicine can approach in-person care on some clinical indicators. Bracken et al. [6] compared subsequent utilization differences between physician-led synchronous telehealth and in-person care at the systematic review level. By contrast, Hammersley et al. [41] suggested that consultation content and quality are not fully equivalent across video, telephone, and face-to-face media. That is the practical boundary. Physical examination, emergency judgment, and complex communication make straightforward substitution less defensible, even when the disease category seems suitable for remote follow-up.

Payment and incentives shape whether telemedicine becomes normal practice. The evidence here is mixed in type, but the direction is still useful. In work directly focused on telemedicine policy, Jetty et al. [14] called for permanent restructuring of telemedicine reimbursement in the United States. Using multicountry clinic data, Kirk et al. [42] showed that national Internet infrastructure and fee environments influence video consultation use. Therefore, telemedicine substitution is partly a payment and infrastructure question, not only a clinical one.

Infrastructure and institutional settings sit underneath substitutive use. Through a five-country policy comparison, Srivastava et al. [28] showed that national institutions shape virtual primary care pathways. The relational layer matters too: Ramachandran et al. [43] and Steele Gray et al. [44] showed that eHealth is not only a technical tool; it also reshapes physician-patient relationships and therapeutic trust. Availability is only the first condition. Remote care is actually used when institutions, workflows,

clinicians, and patient relationships make it usable.

These factors lead to a restrained conclusion. A service does not become substitutable simply because it can be delivered online. Remote care can carry the work safely only when patient capacity, clinical task, organizational readiness, payment conditions, infrastructure, and trust relationships line up closely enough.

6. Potential benefits of telemedicine substitution

The strongest benefit evidence concerns access, especially waiting time and referral efficiency. Livingstone and Solomon's [16] cost-effectiveness evaluation of teledermatology in general practice found economic advantages in the store-and-forward model. Liddy et al. [15] followed Canada's Champlain BASE eConsult service over five years and 14,105 consultations; approximately 65% of eConsult cases were resolved without a subsequent in-person specialist visit, and approximately 40% of cases originally planned for referral avoided an unnecessary in-person visit through eConsult. That supports a cautious inference, not a sweeping one. Substitution is most persuasive when it removes avoidable travel, waiting, or referral steps while keeping clinical responsibility clear.

Rural and underserved settings show why access cannot be treated as a purely technical gain. Ohl et al. [38] showed that telehealth and shared-care programs may reduce distance barriers to specialist services for HIV patients. Hser et al. [17] extended this logic to rural OUD services through a coordinated care model linking primary care with external MOUD providers. In these cases, remote care has equity value because it is embedded in a local primary care pathway. The benefit is not automatic. Digital literacy, broadband availability, language, trust, and local staffing still decide who can actually use remote care.

Additionally, recent evidence shifts attention from whole systems to particular tasks. The strongest benefit evidence in this review does not show primary care being replaced as an institution. It shows selected tasks, information flows, referrals, and specialist advice being redistributed within primary care pathways. These are pathway-level gains, not proof that remote care reduces total workload. The older access narrative is too simple. Telemedicine's value lies in changing specific service links, not in replacing primary care as a setting.

7. Boundaries and limitations of telemedicine substitution

The boundaries of substitution are clearest where remote care is asked to carry work that depends on uncertainty, touch, complex judgment, or relationships. Clinical uncertainty, physical examination, complex multi-morbidities, cognitive impairment, digital exclusion, relational care, and safety risk all limit what can reasonably be moved online.

Some encounters cannot be moved safely into remote channels. By drawing on remote primary care patient safety incidents and clinic cases, Payne et al. [20] found that patients with complex multi-morbidities, ambiguous symptoms, and cardiovascular or abdominal emergencies were more likely to experience diagnostic delays or judgment errors under remote models. The quality and relationship evidence adds a second caution. Payne et al. [7] showed that "humanizing elements" such as relational care, compassion, and support are harder to provide consistently in hybrid general practice. By drawing on private video consultation and video/telephone/in-person quality comparisons, Salisbury et al. [45] and Hammersley et al. [41] suggested that different media are not functionally equivalent by default.

These limits rest mainly on safety-incident analyses and qualitative accounts rather than controlled comparisons. They should be read as well-grounded caution, not as evidence of the same type as the reviews supporting substitution.

Safety risk does not sit at one point in the system. Payne et al. [20] showed the diagnostic side of the problem: remote primary care may create safety risks for patients with complex symptoms or high clinical risk. In PrEP telecare, Zhang C et al. [35] pointed to a service-quality problem, where convenience may come at the cost of empathy, connection, and perceived quality. Darley et al.'s [46] systematic review moves the issue to system design, showing that online consultation quality depends on how remote access, information gathering, clinical review, and follow-ups are organized. This is why substitutability has to be judged across the whole pathway, not only at the moment of the remote encounter.

Trust and communication are less visible than diagnostic safety, but they are not secondary. Ramachandran et al. [43] summarized the effects of eHealth on primary care physician-patient relationships and trust. Using social representations in digital media, Steele Gray et al. [44] explained how technology changes therapeutic relationships. For special populations, Selick et al.'s [21] interviews with patients with intellectual and developmental disabilities showed that virtual environments can weaken nonverbal cues, bodily perception, and clinical intuition. The loss of warmth in telemedicine is not just a preference problem; it reflects changes in relational trust, communication cues, and professional roles.

At the system level, substitution is easy to overstate. It should be assessed through overall utilization and workload, not only by counting how many individual visits were converted to remote care. In a systematic review of 19 studies, Bracken et al. [6] found that physician-led synchronous telehealth visits in primary care were followed by emergency department visits, hospitalizations, and prescriptions at levels similar to, or lower than, those observed after in-person visits. Within the primary care settings examined in that research, physician-led synchronous telehealth did not show a clear tendency to increase downstream utilization, although the interpretation still depends on the study's design and context. Fahim et al.'s [27] Alberta claims analysis added a different caution: the share of the population with at least one primary care visit improved from a 9.55% decline in 2020/21 to a 4.62% decline in 2022/23, but post-pandemic primary care utilization still had not fully returned to pre-pandemic levels. Remote models can fill gaps. Whether they can fully substitute for in-person care needs longer-term evidence.

Disadvantaged groups make the access problem especially visible. Neves et al.'s [47] study of public perspectives during the pandemic in the United Kingdom showed how virtual models can produce quality and safety concerns for patients. Substitution may improve access for one group while reducing usable care for another, especially when digital access, language support, disability accommodation, or caregiver support is weak.

The physical boundary is most concrete where examination, equipment, or immediate procedures are needed. Kornelsen et al.'s [22] study of point-of-care ultrasound use by rural family physicians showed that some primary care judgments depend on on-site equipment, physical contact, and immediate procedures. Purely remote models struggle with that kind of work. Cognitive impairment makes the problem more pronounced; Klinton et al. [33] documented the difficulties caregivers of patients with dementia face in remote models. By examining the balance between patient autonomy and physician judgment, Muellers et al. [48] showed that remote decision-making is also a matter of risk-sharing and responsibility allocation. The issue is not simply whether a consultation can be held

online.

These limitations lead to a narrower conclusion. Telemedicine can substitute for selected primary care tasks and encounters, but it cannot replace the diagnostic, physical, relational, and risk-management work that still requires in-person care.

8. Discussion

The evidence does support a substitutive role for telemedicine in primary care. The limits are narrow. Remote care is most defensible when the encounter is low risk, information-rich, relatively standardized, and tied to follow-up rather than first diagnosis. Chronic disease follow-up, prescription renewal, remote specialist advice, selected behavioral health encounters, and structured screening or triage tasks fit this pattern. The boundary appears somewhere else: diagnostic uncertainty, physical examination, complex multi-morbidities, cognitive impairment, relational care, and clinical risk management. That leaves a fairly practical conclusion. Telemedicine can take over selected tasks inside a hybrid model, while in-person care remains necessary for diagnostic, physical, relational, and high-risk work.

The care pathway is the easiest place to see the benefit. eConsult, teledermatology, remote monitoring, and structured screening tools do not remove the need for primary care. They can remove avoidable steps, shorten referral chains, or bring information and specialist advice earlier into the decision process. That is a modest claim, though it matters anyway. A remote encounter has value when it makes the next clinical decision clearer, faster, or less burdensome; it is much less useful when the same uncertainty is simply passed into another channel.

The key distinction is not online versus offline care. It is the site of care versus the task of care. Much of the debate treats an online encounter as if it were a direct counterpart to an in-person visit, but the studies in this corpus point to a more precise reading: telemedicine substitutes most convincingly when the task is already well defined, the necessary information is available, and the risk is low or stable. It becomes weaker when the encounter is meant to discover the problem, build trust, examine the body, or make a judgment under uncertainty. That is why the same technology may look useful in chronic disease follow-ups and incomplete in first-contact diagnoses.

The literature has shifted as well. Earlier work often asked whether telephone, video, or asynchronous consultation could work at all. Later work asks a sharper question: which clinical tasks, which patients, and which organizational conditions make remote substitution acceptable? The strongest evidence appears where remote care reduces unnecessary visits or referrals, brings specialist advice into primary care, or supports continuing monitoring. Weaker evidence often comes from protocols, short implementation reports, and patient experience studies. These studies are still useful, but they usually show feasibility more often than durable substitution.

One question remains awkward: does telemedicine reduce burden or does it move burden elsewhere? Some studies point to shorter waiting times, fewer unnecessary specialist visits, and lower travel costs. Others raise concerns about diagnostic risk, induced demand, fragmented workflows, and the weaker communication for patients with complex symptoms, cognitive impairment, disability, or limited digital access. A remote visit may replace one face-to-face appointment. Additionally, it may generate messages, safety checks, follow-up calls, or later in-person assessments. For patients, that may still feel convenient. For primary care teams, the work may simply appear at a different point in the pathway.

Equity is similarly unsettled. Telemedicine can improve access for rural patients, people with mobility constraints, and groups facing stigma or distance barriers. Additionally, it can exclude patients who lack devices, broadband, language support, private space, digital skills, or trust in online systems. Access is not created by the remote modality alone. It depends on local staffing, navigation support, patient education, and a workable route back to in-person care when remote contact is not enough.

Several limits narrow the argument made here. The corpus is based on English-language publications indexed in the Web of Science Core Collection, so non-English health systems and local implementation reports may be underrepresented. Moreover, the search relied on a single database and did not include MEDLINE/PubMed, Embase, or CINAHL; some relevant primary care studies may therefore have been missed. Because the search strategy was originally designed to capture a broad primary-care digital health corpus rather than a telemedicine-only corpus, some telemedicine-specific studies may also have been missed. Most included studies come from a small number of high-income countries with relatively strong primary care systems, which limits transferability to lower-resource and non-Western settings. This is an evidence-informed synthesis, not a quantified effect estimate. The review uses thematic synthesis rather than PRISMA-based systematic review procedures or GRADE scoring, and the included studies vary widely in design, technology type, service context, and outcome measures. The strongest claims rest on a small number of systematic reviews and one meta-analysis, mainly Mabeza et al. [5], Zhang A et al. [9], and Bracken et al. [6]. Much of the remaining corpus consists of protocols, qualitative work, and single-site reports that inform mechanism and context more than effect.

Future work needs sharper measurements. How should substitution be measured? Which tasks can be shifted safely? How does remote care affect workload and follow-up over time? These questions matter most for complex patients, disadvantaged groups, and chronic illness care across health systems. Although the search included terms such as “artificial intelligence” and “AI,” this review did not set out to review AI health or AI medicine as a separate area. The question here is narrower: when telemedicine can and cannot stand in for in-person primary care. AI-based tools may sit inside telemedicine services (e.g., in triage, decision support, remote monitoring, or patient-clinician communication). Still, they bring a different set of issues, especially around clinical judgment, responsibility, safety, and equity. For that reason, AI-enabled telemedicine and AI medicine in primary care need more focused review in future work.

Two policy-relevant gaps remain thin in this corpus. Cost evidence is limited to a few studies, including Livingstone and Solomon [16] and Liddy et al. [15], so it is still unclear whether substitution saves money for systems, payers, or patients. Workforce effects are even less settled. A remote visit may move clinician work in time and place rather than remove it, and its effect on workload and burnout is rarely measured. These should stay open questions, not assumed gains.

9. Conclusions

Telemedicine does have a substitutive role in primary care. The role is real, but limited. It works best when the task is stable, defined, and able to be managed with information that can travel through remote channels. Chronic disease follow-up, prescription renewal, remote monitoring, selected behavioral health encounters, eConsult, teledermatology, and structured screening or triage fall into this category. In these settings, remote care can reduce avoidable visits, shorten referral pathways, and bring specialist advice or clinical information earlier into the care process.

The limits are not minor exceptions. Telemedicine is poorly suited to first-contact diagnoses, emergencies, ambiguous symptoms, complex multi-morbidities, physical examination, procedures requiring touch or equipment, and encounters where trust, non-verbal cues, or relational continuity are central. These are core parts of primary care. For that reason, substitution is best understood at the level of tasks and service links, not at the level of primary care as an institution.

Additionally, remote care needs safeguards before it can function as a substitute: sensible triage, appropriate patient selection, digital access, workable clinical routines, reimbursement, and safety monitoring. Without these conditions, telemedicine may shift work rather than reduce it. Moreover, it may improve access for some patients while excluding others. Future studies should move beyond visit counts and compare remote, in-person, and hybrid pathways in terms of workload, downstream use, quality, safety, patient experience, equity, and cost.

The conclusion is deliberately restricted. Telemedicine can substitute for selected encounters, but it cannot replace the clinical judgment, physical examination, local responsibility, and continuous relationships that define in-person primary care. Future service design should start from that boundary.

Author contributions

Yifan Zhao: Conceptualization, Writing–original draft; Dahai Zhao: Conceptualization, Supervision. All authors have read and agreed to the published version of the manuscript.

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Conflict of interest

All authors declare no conflicts of interest in this paper.

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