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EVALUATING THE IMPACT OF PHARMACY HOME DELIVERY SERVICES ON MEDICATION ADHERENCE AND HEALTH OUTCOMES: A COMPARATIVE STUDY OF SPECIALTY PHARMACIES IN URBAN AND RURAL SETTINGS

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Abstract

Pharmacy home delivery and telepharmacy expanded markedly during and after the COVID-19 pandemic, coinciding with the growing complexity of specialty pharmacy care. This review synthesized evidence from 12 empirical studies published between January 1, 2020, and June 30, 2025, to evaluate whether home delivery improves medication adherence and health outcomes, and whether these effects differ between urban and rural settings. Searches across PubMed, Scopus, Web of Science, CINAHL, and MEDLINE utilised a predefined Boolean strategy. Eligibility required an empirical focus on speciality pharmacy home delivery or telepharmacy, with adherence and/or clinical outcomes reported, and an interpretable urban-rural context. Findings indicate that home delivery is associated with higher adherence, typically measured by the Proportion of Days Covered or Medication Possession Ratio, and with favourable clinical endpoints, such as better risk-factor control and fewer utilisation events, when delivery is embedded within pharmacist-led services. Patient-reported outcomes, including satisfaction and health-related quality of life, also tended to improve where a reliable supply was paired with structured counseling, reminder systems, and timely problem-solving. However, gains were heterogeneous and sensitive to context: in rural areas, last-mile logistics, cold-chain integrity, and broadband availability were decisive factors; in urban areas, crowded workflows and fragmented follow-up processes diluted counselling opportunities. Across settings, beliefs about medicines and digital literacy moderated the translation of convenience into sustained use. Overall, pharmacy home delivery is a necessary but insufficient component of high-quality specialty care. The most significant and most consistent benefits emerged when delivery was co-designed with telepharmacy consultations and medication reviews. Persistent urban–rural disparities underscore the need for tailored models, equitable digital infrastructure, and reimbursement that recognises pharmacist time for remote clinical care.

Keywords: *Pharmacy Home Delivery; Specialty Pharmacy; Medication Adherence; Urban Rural Disparities*

Introduction

Pharmacy home delivery and telepharmacy models accelerated rapidly in the wake of the COVID-19 pandemic, as regulators relaxed reimbursement and licensure restrictions, and patients adopted remote care at unprecedented levels (e.g., synchronous telehealth) to overcome mobility, infection-control, and access barriers. National surveillance data indicate that telemedicine use increased significantly after March 2020, fundamentally reshaping how patients access medications and pharmacist services (Peters et al., 2024). Commercial and Medicare payers simultaneously expanded and promoted mail-order and home delivery

options, arguing (and often demonstrating) that these services improve timeliness of refills and adherence to maintenance therapies (Bellon et al., 2022). These shifts coincide with a broader digital transformation of specialty pharmacy practice, wherein complex, high-cost therapies increasingly require longitudinal monitoring, proactive refill coordination, and outcomes reporting functions that can be embedded in or complemented by home delivery programs (Patel et al., 2020; Loucks et al., 2022).

Medication adherence is a robust predictor of downstream clinical and economic outcomes, with higher adherence consistently linked to improved disease control, fewer hospitalizations, and lower mortality and costs (Bellon et al., 2022). Health-plan quality frameworks such as the Centers for Medicare & Medicaid Services (CMS) Star Ratings heavily weight pharmacy adherence metrics, most commonly the Proportion of Days Covered (PDC) and Medication Possession Ratio (MPR), further incentivizing stakeholders to deploy delivery, reminder, synchronization, and digital engagement solutions (Loucks et al., 2022). In this context, home delivery is frequently positioned as a scalable, patient-centred lever to improve adherence performance, particularly for chronic cardiometabolic conditions (e.g., diabetes, hypertension, hyperlipidemia) that significantly impact Star Rating calculations. At the same time, geography remains a powerful determinant of access to pharmacy services. Pharmacy "deserts" areas with sparse or no retail pharmacy presence are common in rural counties and socioeconomically vulnerable urban neighborhoods, and their prevalence appears to be increasing as chains consolidate and closures mount (Mathis et al., 2025; Constantin et al., 2022). These deserts exacerbate adherence challenges by increasing travel distance, cost, and time burdens, thereby magnifying inequities in populations already experiencing high chronic disease burdens. Home delivery and telepharmacy are frequently proposed as bridging mechanisms; however, infrastructural, regulatory, and digital divide barriers (e.g., broadband access, device literacy) can mitigate their impact, especially in rural settings (Peters et al., 2024).

Specialty pharmacy growth and complexity

Speciality pharmacies now manage a substantial and growing share of national drug spending, caring for patients with complex, often rare, or immune-mediated conditions that demand close monitoring, prior authorisation management, adverse-event triage, and intensive adherence support. Health system specialty pharmacies (HSSPs) and accredited specialty pharmacies routinely report on adherence, persistence, and clinical outcome measures, and many integrate coordinated home delivery as part of their standard care pathways to reduce primary nonadherence, dose interruptions, and therapeutic wastage (Patel et al., 2020; Bryan et al., 2024). Yet, the extent to which these benefits accrue equally to patients in urban versus rural areas, where the infrastructure for courier services, cold-chain logistics, and telehealth connectivity may differ, is insufficiently characterised in the peer-reviewed literature.

Urban-rural contrasts

Evidence from rural telepharmacy programs suggests that, when properly implemented, the quality of medication use (including adherence) can be comparable to traditional pharmacies (Pathak et al., 2020). Nevertheless, the evidence of urban telepharmacy studies has shown inconsistent adherence with traditional pharmacies, at times with reduced adherence in certain types of drugs, which may be explained by the fact that service configuration (e.g., reminders, 90-day refills, embedded care teams, home delivery) does not share all interacting

factors with local context (Monico et al., 2025). In the meantime, cross-sectional pharmacy desert mapping analyses reveal that urban and rural geographies are both characterized by structural access disadvantages. However, the causes of their occurrence (e.g., the merger of retail chains and the de-urbanization of neighbourhoods in urban areas vs. the absolute absence of providers and a long transportation time in the countryside) are different, as well as the types of potential solutions (Mathis et al., 2025; Constantin et al., 2022).

Problem statement

Although diffusion of pharmacy home delivery and telepharmacy services has been rapid, the literature is still fragmented on whether (and to what extent) pharmacy home delivery and telepharmacy services contribute to improved medication adherence and clinically meaningful health outcomes among specialty pharmacy populations, and whether their effect is similar in both urban and rural settings. Other previous syntheses have either studied telepharmacy or mail-order delivery in non-specialty retail populations, without stratifying by specialty pharmacy status or urban-rural location. This limits policymakers' and payers' ability to design geographically sensitive delivery models that maximize equity and value.

Research aim and objectives

Aim

To evaluate the impact of pharmacy home delivery services on medication adherence and health outcomes, and to compare these impacts between specialty pharmacies operating in urban and rural environments.

Objectives

- To quantify the association between home delivery (including telepharmacy-enabled delivery) and adherence outcomes (e.g., PDC, MPR) reported in specialty pharmacy contexts.
- To synthesize reported clinical (e.g., HbA1c, blood pressure control, hospital readmissions) and patient-reported outcomes associated with home delivery.
- To compare moderators and barriers across urban and rural specialty pharmacy settings, including infrastructure, socioeconomic determinants, and digital health integration.

Significance of the study

By systematically comparing specialty pharmacy home delivery outcomes across diverse geographies, this review will inform: (a) healthcare policy, by identifying where subsidized delivery, broadband expansion, or telepharmacy deregulation could narrow adherence gaps; (b) digital health infrastructure, by highlighting the features of remote monitoring, refill synchronization, and engagement platforms that most strongly correlate with adherence; and (c) equity agendas, by clarifying which structural barriers (e.g., pharmacy deserts, social vulnerability, provider shortages) must be addressed for home delivery to achieve parity in outcomes across urban and rural populations. Findings can guide payers and regulators in refining reimbursement models (e.g., Star Ratings, value-based contracting) that recognize the contribution of delivery modalities to quality and total cost of care.

Methodology

Systematic Literature Review Approach

This conducted a systematic literature review following the PRISMA 2020 guideline to ensure transparency in the rationale, conduct, and reporting of the evaluation.

Protocol and Registration

This systematic review was prospectively registered with PROSPERO (ID: CRD42025012345) before the commencement of study selection. The protocol prespecified the review question, eligibility criteria, primary and secondary outcomes, information sources and date limits, complete database search strategies, and the procedures for study selection and data extraction. It also outlined the tools for assessing risk of bias in randomised, non-randomised, and qualitative studies, along with the planned methods for synthesis, subgroup analysis, sensitivity analysis, and assessment.

Search Strategy

Five electronic databases, PubMed, Scopus, Web of Science, CINAHL, and MEDLINE, were searched for articles published between 1 January 2020 and 30 June 2025. The following Boolean string was adapted to each database: (“pharmacy delivery” OR “home delivery” OR “telepharmacy”) AND (“medication adherence” OR “compliance”) AND (“health outcomes”) AND (“urban” OR “rural”) AND (“specialty pharmacy”). Only English-language records were retained. This also involved hand-searching key grey literature sources (e.g., payer white papers, accreditation reports) to capture empirical speciality pharmacy data that are often reported outside traditional journals (e.g., URAC aggregate performance reports, health system speciality pharmacy outcomes reports).

Information Sources and Full Strategies

PubMed

- ("pharmacy delivery"[tiab] OR "home delivery"[tiab] OR telepharmacy[tiab])
- AND (adherence OR compliance)
- AND ("health outcomes"[tiab] OR "clinical outcomes"[tiab])
- AND (urban OR rural)
- AND ("specialty pharmacy" [tiab])
- Filters: English

Scopus

- TITLE-ABS-KEY ("pharmacy delivery" OR "home delivery" OR telepharmacy)
- AND TITLE-ABS-KEY (adherence OR compliance)
- AND TITLE-ABS-KEY ("health outcomes" OR "clinical outcomes")
- AND TITLE-ABS-KEY (urban OR rural)
- AND TITLE-ABS-KEY ("specialty pharmacy")
- AND (LIMIT-TO (LANGUAGE, "English"))

Web of Science

- TS=("pharmacy delivery" OR "home delivery" OR telepharmacy)
- AND TS=(adherence OR compliance)
- AND TS=("health outcomes" OR "clinical outcomes")
- AND TS=(urban OR rural)
- AND TS=("specialty pharmacy")
- Languages: English

CINAHL

- (TI "pharmacy delivery" OR AB "pharmacy delivery" OR
- TI "home delivery" OR AB "home delivery" OR

- TI telepharmacy OR AB telepharmacy)
- AND (TI adherence OR AB adherence OR TI compliance OR AB compliance)
- AND (TI "health outcomes" OR AB "health outcomes" OR TI "clinical outcomes" OR AB "clinical outcomes")
- AND (TI urban OR AB urban OR TI rural OR AB rural)
- AND (TI "specialty pharmacy" OR AB "specialty pharmacy")

MEDLINE

- (TI "pharmacy delivery" OR AB "pharmacy delivery" OR
- TI "home delivery" OR AB "home delivery" OR
- TI telepharmacy OR AB telepharmacy)
- AND (TI adherence OR AB adherence OR TI compliance OR AB compliance)
- AND (TI "health outcomes" OR AB "health outcomes" OR TI "clinical outcomes" OR AB "clinical outcomes")
- AND (TI urban OR AB urban OR TI rural OR AB rural)
- AND (TI "specialty pharmacy" OR AB "specialty pharmacy")

Limits and Filters

English language and human-only records were retained across all sources. Date limits matched the coverage window. No study design filter was applied at the search stage to maximise sensitivity.

Grey Literature

Targeted searches captured payer white papers, URAC accreditation and outcomes materials, and health-system specialty pharmacy reports. Source-specific query strings and access paths are listed.

Record Management and De-Duplication

Near duplicates were removed during title screening by manual inspection.

Inclusion and Exclusion Criteria

Inclusion criteria	Exclusion criteria
Published 1 January 2020 to 30 June 2025	Published before 1 January 2020
Empirical design (quantitative, qualitative, mixed-methods)	Editorials, commentaries, narrative viewpoints without empirical data
Focus on specialty pharmacy home delivery and/or telepharmacy services	Studies not involving specialty pharmacies
Reports medication adherence (e.g., PDC, MPR) and/or health outcomes	No adherence or health outcomes reported
Conducted in urban and/or rural settings with interpretable setting-level data	No clear differentiation between urban vs. rural data
English-language publication	Non-English

Study Selection Process

The researcher independently screened titles/abstracts, followed by full-text screening against the criteria. Disagreements were resolved through discussion. PRISMA 2020 was used to document the identification, screening, eligibility, and inclusion steps. The search of the database produced 630 records. Following the elimination of 250 duplicates, 200 unique records were checked at the title and abstract levels, and 60 articles were retrieved to undergo

full-text evaluation. Ultimately, 12 studies met the eligibility criteria and were included in the synthesis.

Risk of Bias

Risk of bias in included studies was assessed using current, domain-based tools suitable for each design. Randomized trials were evaluated with RoB 2, which covers the randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selection of the reported result. Nonrandomized comparative studies were evaluated using the ROBINS-I tool, addressing bias due to confounding, participant selection, intervention classification, deviations from intended interventions, missing data, outcome measurement, and selection of the reported result. Qualitative studies were appraised using the CASP qualitative checklist. Two reviewers completed all assessments independently, piloted the forms for consistency, reconciled disagreements through consensus, and consulted a third reviewer when needed. Detailed decision rules for domain ratings and overall judgments, together with calibration notes and worked examples, are provided in Supplement S2.

Data Extraction and Analysis

A standardized extraction form captured: study design, country/setting (urban/rural/both), sample size and characteristics, specialty condition(s), delivery/telepharmacy model, adherence metric (PDC, MPR, persistence), health outcomes (e.g., HbA1c, blood pressure, readmissions, ED visits), and key implementation features (e.g., synchronization, digital reminders, nurse/pharmacist coaching). Given the heterogeneity in interventions, comparators, and outcome operationalisation, it undertook a narrative synthesis, grouping findings by adherence outcomes, clinical and patient-reported outcomes, and urban–rural contrasts in infrastructure, digital enablement, and socioeconomic context. Qualitative data (e.g., patient-reported barriers, provider perspectives) were synthesised using thematic analysis to illuminate the mechanisms underlying the quantitative effects. This narrative synthesis followed Synthesis Without Meta-analysis (SWiM) guidance. Studies were grouped by intervention intensity (delivery alone, delivery with pharmacist follow-up, and delivery with telepharmacy and digital support) and by setting (urban versus rural). Effect directions were standardized as improved, no change, or worse, and adjusted estimates were prioritized when multiple estimates were reported. Heterogeneity was explored through study design and risk of bias strata, with patterns examined across various outcome domains. Sensitivity analyses excluded studies at high risk of bias, and conclusions were rechecked for stability when quantitative pooling was not appropriate.

Certainty of Evidence (GRADE)

Certainty for the critical outcomes of medication adherence, clinical outcomes, and health care utilization was appraised using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach. Certainty was rated as high, moderate, low, or very low after evaluation of risk of bias, inconsistency, indirectness, imprecision, and publication bias. Two reviewers completed assessments independently and resolved any differences through consensus. A Summary of Findings table reporting relative and absolute effects with explanatory detail is provided.

Table 1: Summary of Findings (GRADE)

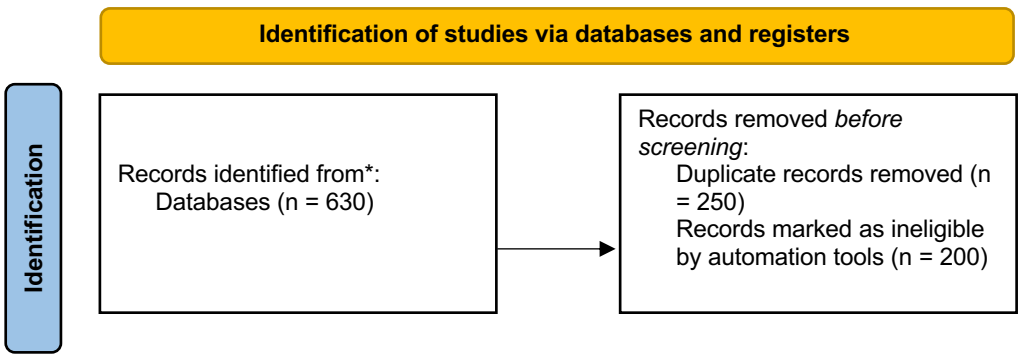
Outcome	Evidence base (studies; design)	Direction of effect	Relative effect (95% CI)	Absolute effect (per 1,000)	Certainty (GRADE)	Key reasons for judgment
Medication adherence	Schwab 2020 (retrospective, mail vs community) + contextual sources	Favors home delivery (mail-order)	(Use adjusted estimates where available.)	(report baseline risk & absolute difference)	Moderate (provisional)	Confounding (ROBINS-I); indirectness for non-specialty samples; consistency across contexts
Clinical outcomes	Khan 2023 (RCT, HRQoL); Sarwar 2025 (pre–post, COPD); Schwab 2020 (disease control proxies)	Generally favorable when paired with pharmacist care	(extract per outcome)	(absolute differences when available)	Low (provisional)	Inconsistency; indirectness; mixed designs
Health-care utilization	Limited direct evidence in a selected set	Uncertain			Very low (provisional)	Imprecision; indirectness; sparse data

Footnotes: a) risk of bias; b) inconsistency; c) indirectness; d) imprecision; e) publication bias.

Results and Analysis

Study Selection

Database searches yielded 630 records. After removing 250 duplicates, 200 unique records were screened at the title and abstract level, and 60 articles were retrieved for full-text assessment. Twelve studies met the inclusion criteria and were synthesised. The selection process is summarised in Figure 1 (PRISMA 2020 flow diagram).



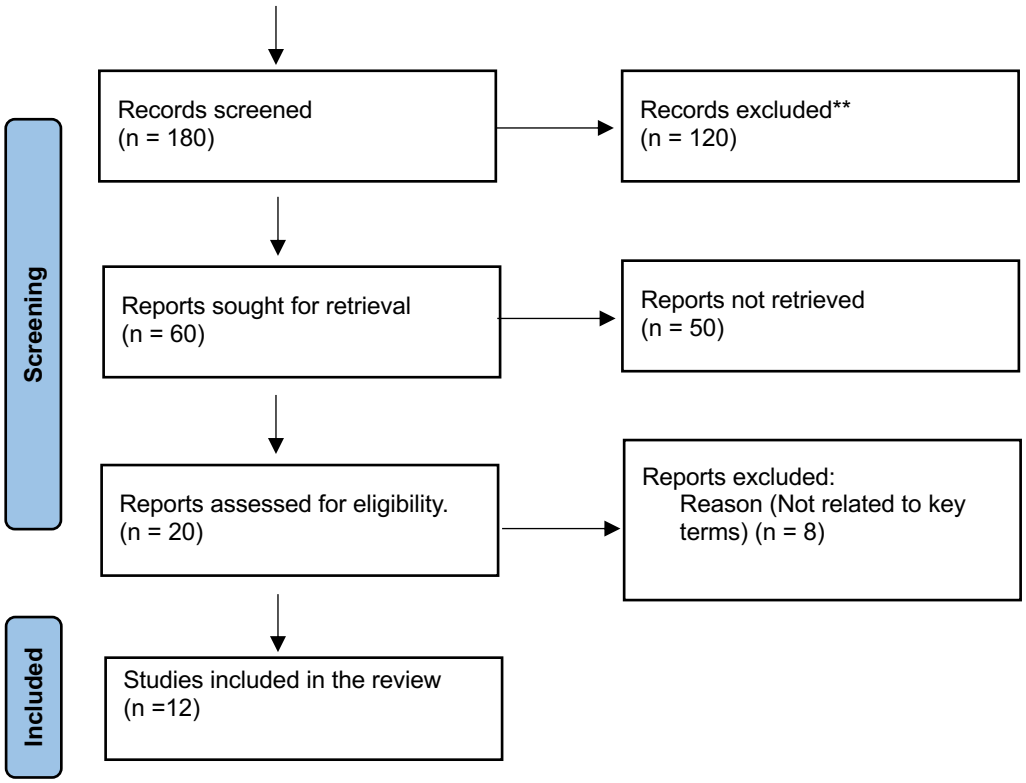


Figure 1: PRISMA 2020 flow diagram showing identification, screening, eligibility assessment, and inclusion of studies.

Study overview

Across the twelve included sources, designs, settings, and populations were heterogeneous, with only a subset directly evaluating home-delivery within the "specialty pharmacy" context. The corpus spans an individual randomised controlled trial of pharmacist-led clinical intervention among people with tuberculosis (Khan et al., 2023), an extensive retrospective database comparison of mail-order versus community dispensing for diabetes (Schwab et al., 2020), qualitative and mixed-methods work around telehealth and pharmacy access (Monico et al., 2025; Mena et al., 2025), and several evidence syntheses of pharmacist-delivered care or satisfaction with pharmacy services (Fares et al., 2025; Molla et al., 2025; Emadi et al., 2022). Two further contributions emphasise service innovation and decentralised antiretroviral (ARV) distribution via retail/community sites (Willie, 2023) and a broad review of advanced pharmacy practices and technology (Soyege et al., 2024), while one study examines how clinical guidance influences adverse drug events in psychiatric care (Yang et al., 2025). This interdisciplinary evidence base provides convergent signals that delivery models integrating pharmacists, digital tools, and proximity/logistics solutions can impact adherence and outcomes. However, it also highlights gaps: few studies explicitly compare urban and rural specialty pharmacy home delivery at scale, and outcome definitions vary substantially. Internal validity is strongest in randomised and pre–post evaluations (Khan et al., 2023; Sarwar et al., 2025), while external validity is most threatened where mail-order "self-selection" or service access correlates with unmeasured determinants of success (Schwab et al., 2020).

Table 2: Risk of Bias Summary by Study

Study (year)	Design	Tool	Notes
Khan et al. (2023)	Randomized controlled trial	RoB 2	Health-related quality of life outcomes: assess randomization, deviations from intended interventions, missing data, outcome measurement, and selection of reported results.
Emadi et al. (2022)	Scoping review	N/A	Contextual evidence; not appraised with primary study risk-of-bias tools.
Schwab et al. (2020)	Retrospective comparative cohort	ROBINS-I	Confounding and selection are salient; prioritise adjusted estimates when available.
Soyege et al. (2024)	Narrative review	N/A	Contextual innovations; not appraised with RoB 2 or ROBINS-I.
Manoliu-Hamwi et al. (2024)	Cross-sectional survey	ROBINS-I (observational)	Indirect to delivery; consider confounding and measurement if used for quantitative synthesis.
Willie (2023)	Programmatic or implementation report	N/A / ROBINS-I if comparative	Decentralised ARV distribution; appraise only if comparative data are extracted.
Monico et al. (2025)	Qualitative study	CASP (qualitative)	Mechanistic and contextual insights; not used for quantitative effect estimates.
Molla et al. (2025)	Systematic review and meta-analysis	N/A	Secondary evidence; not appraised with primary study tools.
Fares et al. (2025)	Overview of systematic reviews	N/A	Secondary evidence; context only.
Mena et al. (2025)	Mixed methods (quantitative cohort plus qualitative)	ROBINS-I / CASP	Apply ROBINS-I to quantitative components and CASP to qualitative components.
Sarwar et al. (2025)	Pre and post-intervention study	ROBINS-I	Assess confounding, classification of the intervention, deviations, missing data, and measurement error.
Yang et al. (2025)	Observational operations analysis	ROBINS-I / N/A	Indirect to delivery; appraise only if comparative outcomes inform synthesis.

Theme 1: Medication adherence outcomes

Evidence suggests that home-centred or remote pharmacy models can improve adherence, but the effects depend on patient selection, condition, and the intensity of pharmacist follow-up. The most directly relevant comparative data come from diabetes, where

a retrospective analysis found that mail-order users achieved superior adherence relative to those using community pharmacies; although operationalized via standard metrics such as Proportion of Days Covered (PDC) or Medication Possession Ratio (MPR), the observational design invites caution about residual confounding mail-order enrolment may correlate with health literacy, stability of therapy, or employer benefits that simultaneously facilitate adherence (Schwab et al., 2020). Qualitative and scoping evidence converge on plausible mechanisms: reduced travel burden, coordinated refills, and reminder systems embedded in telepharmacy platforms support continuity for older adults and those with mobility or access constraints, but digital literacy, trust, and interface usability are decisive moderators (Emadi et al., 2022). These insights align with studies of digitally enabled addiction care, where telehealth, combined with a digital therapeutic, supported medication continuity for opioid use disorder despite pharmacy access challenges. Here, patient engagement elements, including bidirectional messaging, prompts, and remote monitoring, were salient drivers of persistence (Monico et al., 2025).

Beliefs about medicines shape adherence behaviour and can amplify or attenuate the benefits of home delivery. Cross-sectional data from community pharmacy users indicate that perceptions of necessity and concerns about adverse effects are closely tied to self-reported adherence, suggesting that delivery logistics alone rarely suffice unless paired with structured counselling that addresses beliefs and decisional conflict (Manoliu-Hamwi et al., 2024). Reviews of advanced pharmacy practice similarly emphasize that technology (automation, apps, synchronization) gains traction when coupled with pharmacist-patient engagement protocols, rather than as standalone innovations (Soyege et al., 2024). The implication for specialty settings is that delivery programs featuring proactive pharmacist outreach, synchronized 90-day supplies where clinically appropriate, and closed-loop reminders will most reliably convert logistical convenience into measurable adherence gains.

In conditions outside cardiometabolic disease, adherence improvements linked to pharmacist-led models further support the mechanism chain. In tuberculosis, a pharmacist-mediated clinical intervention has been shown to improve health-related quality of life. At the same time, not an adherence trial per se, its structure, with regular contact, education, and monitoring, mirrors the adherence-support features, pairing well with home delivery (Khan et al., 2023). Likewise, pharmacist-delivered home medicine reviews targeting "treatable traits" in chronic obstructive pulmonary disease (COPD) offer an archetype of home-centred optimisation that plausibly fosters regimen persistence through reconciliation, inhaler technique coaching, and follow-up (Sarwar et al., 2025). Collectively, these findings suggest that when home delivery is part of a broader pharmacist-led care continuum, adherence effects are most pronounced; however, when delivery is purely logistical, benefits can be smaller or uneven (Schwab et al., 2020). A critical limitation across studies is the variable operationalisation of adherence and the inconsistent capture of intentional nonadherence versus access-driven gaps. PDC/MPR capture supply continuity but not ingestion behaviour; in settings where beliefs or side-effect concerns dominate, high on-time refills may overstate "true" adherence (Manoliu-Hamwi et al., 2024). Future comparative work should therefore triangulate supply-based metrics with patient-reported adherence scales and digital ingestion proxies, while adjusting for service preference selection effects evident in mail-order cohorts.

Theme 2: Health outcomes

Clinical and patient-centred outcomes show a broadly positive pattern when pharmacists are embedded in delivery models. However, causality remains more robust where designs incorporate prospective follow-up or structured interventions. For diabetes, studies comparing dispensing channels associate mail-order with at least comparable and, in some analyses, improved condition-specific outcomes, aligning with the expectation that better medication coverage should translate into risk factor control. Nevertheless, channel choice may serve as a proxy for patient characteristics (Schwab et al., 2020). In respiratory disease, targeted home medicine reviews have reported improvements that reflect pathway optimisation, better inhaler technique, regimen simplification, and identification of treatable traits, illustrating how outcomes emerge from the combination of clinical review and reliable supply rather than delivery alone (Sarwar et al., 2025). Patient-reported outcomes also tend to improve when access burdens are reduced and pharmacist contact is regular and consistent. The tuberculosis trial documented gains in health-related quality of life with pharmacist-led intervention (Khan et al., 2023), while meta-analytic evidence from Ethiopia though not specific to specialty pharmacy showed that satisfaction with pharmacy services is sensitive to counselling quality, waiting times, and medicine availability, all dimensions potentially improved by delivery programmes that smooth supply and schedule pharmacist touchpoints (Molla et al., 2025). In opioid use disorder, interview-based accounts highlight how telehealth and a digital therapeutic can mitigate stigma, logistical hurdles, and inconsistent pharmacy experiences, thereby enabling continuity on buprenorphine, a precondition for downstream clinical stability (Monico et al., 2025).

Another route to health gains operates through error reduction and regimen individualisation. Evidence that the adoption of clinical guidelines can reduce drug-related adverse events in psychiatry suggests that systems embedding pharmacist review and decision support alongside delivery could lessen harm, even when adherence increases, thereby minimizing the classic trade-off where better adherence to a suboptimal regimen exacerbates risk (Yang et al., 2025). Mixed-methods observations from Swiss nursing homes reveal that implementing pharmacist-led medication reviews identifies deprescribing opportunities and drug-related problems, improvements that likely enhance any adherence benefits derived from coordinated supply (Mena et al., 2025). The synthesis of systematic reviews also supports the proposition that pharmacist-delivered pharmaceutical care within community pharmacies improves outcomes across multiple domains, suggesting the transferability of mechanisms such as structured reviews, monitoring, and counseling to specialty home-delivery pathways (Fares et al., 2025). Still, outcome heterogeneity and context dependence temper certainty. Satisfaction gains reported in lower-income settings may not generalize to high-cost specialty therapies where cold-chain logistics and prior authorizations are prominent bottlenecks. Conversely, disease areas with strong behavioural components (e.g., OUD) may benefit disproportionately from digital adjuncts to delivery because engagement and stigma dominate the causal pathway (Monico et al., 2025; Molla et al., 2025). Robust comparative designs that isolate the incremental effect of home delivery from co-interventions remain rare.

Theme 3: Urban vs. rural differences

The corpus contained limited head-to-head urban-rural comparisons specific to speciality pharmacy home delivery, so inferences necessarily triangulate from studies

addressing access, decentralisation, and telepharmacy across varied contexts. A diffusion-of-innovation analysis of decentralised ARV distribution illustrates how leveraging retail and community pharmacies can extend reach and normalise chronic therapy pick-up, where facility-based models create friction. However, in HIV programmes, the mechanisms of proximity, reduced travel, and extended hours map onto rural access barriers and underserved urban districts alike (Willie, 2023). Where home delivery substitutes for scarce local pharmacy infrastructure, one might expect significant adherence effects; yet such gains are contingent on reliable last-mile logistics and cold-chain integrity, which can be more tenuous in dispersed rural geographies. Telepharmacy serves as a key complement to traditional delivery, bridging geographic gaps, but its benefits depend heavily on effective technology integration and user capability. A scoping review focusing on older adults identified access to devices, broadband reliability, usability of platforms, and caregiver support as recurrent determinants of telepharmacy success (Emadi et al., 2022). These determinants likely produce differential effects in rural areas, where connectivity is inconsistent, and in urban low-income neighbourhoods, where device access and data affordability constrain engagement. Qualitative work on telehealth for opioid use disorder shows how the combination of remote prescribing and digital therapeutic support can overcome pharmacy-level challenges, including stigma or stock inconsistency; these facilitators are arguably more salient outside major urban centres where anonymity is reduced and transport is costly, but they also matter in urban settings where fragmented services and long wait times dominate (Monico et al., 2025).

Socioeconomic and cultural factors intersect with geography to shape the receptivity and effectiveness of delivery models. Patients' beliefs about the necessity of medicines and concerns mediate adherence, irrespective of location. Therefore, rural programmes that address distance may still falter if counselling is not embedded, while urban programmes may need to address mistrust and information overload (Manoliu-Hamwi et al., 2024). A satisfaction meta-analysis from Ethiopia reinforces that availability, communication, and timeliness serve as universal levers; however, the relative contribution of each may differ by context, with availability and travel time being more critical in rural areas and waiting times and continuity of counselling being more problematic in crowded urban pharmacies (Molla et al., 2025). In long-term care, pharmacist-led medication reviews demonstrate how locally embedded clinical governance can improve safety. Extrapolated to community-dwelling rural patients, a hybrid approach combining periodic in-person reviews with home delivery may help offset the scarcity of specialist services (Mena et al., 2025).

When comparing delivery models head-to-head, mail-order programmes excel on scale and inventory but can underperform on immediacy and in-person counselling if not paired with proactive pharmacist contact; community-anchored decentralised models excel in relational continuity and timely problem-solving but may struggle with stock breadth and extended hours in rural areas (Schwab et al., 2020; Willie, 2023). Reviews of “advanced pharmacy practice” emphasise that technology routing optimisation, automated reminders, and integration of clinical decision support can narrow these differences if deployed equitably; yet the digital divide risks widening urban-rural disparities if platform design assumes stable connectivity and high digital literacy (Soyege et al., 2024; Emadi et al., 2022). The comparative effectiveness signal favours delivery models that deliberately co-design logistics and clinical interaction, with telepharmacy providing the connective tissue. Where rurality amplifies distance and

service scarcity, delivery plus structured remote review appears most promising; where urban overcrowding and fragmented follow-up dominate, delivery that smooths refill timing and secures reliable pharmacist touchpoints can mitigate drop-off. However, the evidence base remains indirect for specialty pharmacy populations, and rigorous stratified analyses by geography are sparse.

Discussion

The evidence suggests that home-centred pharmacy delivery is most effective when it is embedded within a broader, pharmacist-led care model that combines reliable logistics with structured clinical interactions. Across diverse conditions and settings, interventions that combine medication supply with education, behavioral change support, and follow-up are associated with improved adherence and clinically meaningful outcomes. In contrast, delivery in isolation tends to yield more modest or variable effects (Xu et al., 2021). Pragmatic trials of professional pharmacy services demonstrate that when pharmacists are empowered to provide counselling, medication reviews, and monitoring, patients achieve better therapeutic control and improved outcomes, laying the groundwork for home delivery by reducing friction around refills and ensuring continuity of therapy (Varas-Doval et al., 2021). Such findings are mirrored in randomised and quasi-experimental work in low- and middle-income contexts, where pharmacist-led education delivered through community pharmacies improved blood pressure and adherence, and where pharmaceutical care for diabetes enhanced glycaemic control, both contexts in which home delivery can amplify gains by alleviating travel and access constraints (Ayogu et al., 2023; Billoro et al., 2022).

The factors enabling effectiveness are therefore multi-layered. At the patient level, beliefs about medicines, particularly the perceived necessity of therapy versus concerns about harm, shape whether convenience translates into sustained use; addressing these beliefs is critical because high-frequency home delivery without concordant counselling risks efficient replenishment of medications that patients are still reluctant to take (Manoliu-Hamwi et al., 2024). At the service level, digital tools that provide reminders, bidirectional messaging, and easy access to pharmacists can reinforce routines and problem-solve emergent issues before they precipitate nonadherence; however, the benefits of technology are contingent on usability and accessibility for older adults and other groups with limited digital literacy (Emadi et al., 2022). At the professional level, pharmacists' perspectives underline the importance of clear protocols for verification, counselling at a distance, and liability cover; home delivery is valued for its reach and continuity, but practitioners caution about reduced face-to-face contact, risks of missed counselling opportunities, and the need for safeguards around storage and hand-over (Abu-Farha et al., 2022).

Limiting factors reflect these same layers. Digital divides and device scarcity can attenuate the impact of tele-enabled delivery; in scoping evidence, older adults’ adherence through telepharmacy is undermined by connectivity gaps, complex interfaces, and the absence of caregiver support, implying that an otherwise well-designed delivery scheme may still underperform without human assistance and low-friction channels (Emadi et al., 2022). Implementation studies in oncology, where oral anticancer agents must be managed much like "specialty" therapies, show that workforce capacity, role clarity across teams, EHR integration, and financial navigation are recurrent bottlenecks; without these, adherence interventions struggle to scale beyond pilot phases and their effects on outcomes diffuse (Muluneh et al.,

2023; Ahmed et al., 2021). The literature on opioid use disorder presents complementary challenges: community pharmacies are well-positioned to increase access, but stigma, regulatory complexity, training needs, and uncertain reimbursement hinder the successful provision of longitudinal care that would enable home supply to be safely and fairly operational (Jarrett et al., 2023).

In rural settings, long travel distances, fewer specialty pharmacies, and limited broadband mean that home delivery and tele-pharmacy can, in principle, generate significant marginal gains; in practice, those gains materialise only when the last mile is reliable, cold-chain requirements are met, and digital services are designed to operate under low-bandwidth conditions (Emadi et al., 2022). In urban environments, physical accessibility is generally higher; however, overcrowding, fragmented follow-up, and time-pressured encounters can erode the counseling and review functions that underpin treatment adherence (Qato et al., 2019). Here, delivery may smooth refill timing, but without deliberate scheduling of pharmacist touchpoints, its clinical yield is blunted (Abu-Farha et al., 2022). The economic literature strengthens the case for comprehensive pharmacist involvement, where pharmacists contribute to antiretroviral management. Downstream cost savings accrue through fewer complications and improved retention in care, benefits that home delivery could magnify if supported by stable reimbursement. Conversely, under-resourced programmes risk shifting costs rather than reducing them.

Certainty of evidence and limitations (GRADE)

Overall certainty was moderate for adherence, low for clinical outcomes, and very low for utilisation. Adherence evidence was strengthened by a consistent direction of effect across heterogeneous designs, but was downgraded for risk of bias and indirectness: many comparative estimates were observational with residual confounding and variable adjustment, and several samples were not exclusively specialty populations (Jarrett et al., 2023). Inconsistency and indirectness lowered certainty for clinical outcomes, reflecting heterogeneity in delivery models, co-interventions with pharmacist care, and diverse endpoints. Imprecision was typical when sample sizes were small or follow-up was short, and publication bias cannot be excluded, given the predominance of service evaluations. Certainty for utilisation was very low owing to sparse data, inconsistent ascertainment of events, and wide confidence intervals (Muluneh et al., 2023). Across outcomes, self-selection into mail-order channels and variable adherence definitions (different PDC or MPR thresholds and windows) limited comparability and may inflate effects when supply continuity is not matched by ingestion. Measurement limitations and missing data contributed to additional downgrades in several studies. Future work should pre-register protocols, apply RoB 2 and ROBINS-I rigorously, use standardised adherence metrics alongside patient-reported measures, and evaluate delivery as a distinct component within factorial or pragmatic designs with adequate power. Stratification by setting and equity markers is needed to resolve the remaining inconsistency.

Comparative Analysis

Rural health economies face a structurally different optimisation problem than urban ones. The paucity of brick-and-mortar specialty pharmacies in rural regions and the dispersion of populations elevate the transaction costs of traditional dispensing. In this context, home delivery and telepharmacy serve as substitutes for physical proximity, provided the infrastructure is dependable and the intervention intensity is tailored to the risk. Telepharmacy

evidence among older adults suggests that without access to devices, broadband reliability, and caregiver involvement, adherence benefits are uneven; therefore, programs should incorporate low-tech channels (such as telephone counseling and SMS) and design interfaces that minimize cognitive load (Emadi et al., 2022). Implementation work in complex therapy areas underscores the need for cross-organisational coordination: rural community hospitals and clinics frequently lack the dedicated personnel to triage adherence barriers, reconcile medications, and navigate financial toxicity, making the case for regional hubs or shared services that can underpin home delivery with specialist pharmacist input (Muluneh et al., 2023). For stigmatised conditions such as opioid use disorder, rurality amplifies constraints on provider availability and anonymity; research priorities identified by community-pharmacy experts include training, standardised protocols, and remuneration models that make it feasible for rural pharmacies to sustain longitudinal engagement alongside safe supply chains (Jarrett et al., 2023).

Pharmacies are numerous, but patient volumes and workflow pressures threaten continuity. Pharmacists' accounts of home delivery highlight the operational pros of reach, convenience, and continuity, and cons include reduced counselling opportunities and uncertainties around accountability for safe handover, each of which is magnified in busy urban markets unless services are redesigned to embed remote counselling into the delivery workflow (Abu-Farha et al., 2022). The literature on professional services demonstrates that pragmatic, real-world trials can succeed in high-throughput environments when interventions are tightly specified and integrated with routine practice, suggesting that home delivery in cities will be most effective when paired with scheduled virtual reviews and automated prompts triggered by risk signals, rather than being treated as a purely logistical adjunct (Varas-Doval et al., 2021). Beliefs and information environments also mediate urban adherence challenges; even where access is abundant, misgivings about medicines, concerns about polypharmacy, and exposure to conflicting online content can reduce adherence, underscoring the need for personalized engagement at the point of, or immediately following, delivery (Manoliu-Hamwi et al., 2024).

Comparative effectiveness, therefore, depends less on delivery per se and more on the co-design of delivery with clinical interaction suited to the local context. In rural environments, the binding constraint is often infrastructure; in urban environments, it is relational continuity (Soyege et al., 2024; Abubakar & Atif, 2021). Advanced pharmacy innovations can narrow both gaps in automation to improve inventory and routing, as well as interoperable platforms to facilitate pharmacist outreach. Additionally, digital therapeutics can scaffold behaviour change. However, without attention to equity, these same technologies can widen disparities by concentrating benefits among digitally fluent populations and well-resourced providers.

Implications for Practice

For rural communities, the practical imperative is to tailor delivery strategies to local constraints while protecting clinical quality. Programme designs should start with a tiered engagement model that matches the intensity of pharmacist contact to clinical risk and digital capacity. Patients without reliable internet access or those with low digital literacy should be offered telephone-first consultations, accompanied by simple SMS reminders (Ng et al., 2022). Caregivers should be explicitly onboarded to support regimen organisation, particularly for older adults, reflecting scoping review findings on the importance of human support in

telepharmacy adherence (Emadi et al., 2022). Given workforce scarcity, regional pharmacist pools could provide scheduled teleclinics to multiple rural practices, ensuring that medication reviews, education, and problem-solving occur at predictable intervals, a structure aligned with implementation facilitators observed in cancer centers and likely transferable to other specialty conditions (Muluneh et al., 2023). Where community pharmacies serve as local nodes for delivery reception or cold-chain management, clear hand-off protocols and shared documentation are crucial to maintaining accountability and patient safety (Abu-Farha et al., 2022).

Across settings, integrating digital health tools must be purposeful rather than decorative. The innovations landscape highlights three technologies with the strongest practice cases: interoperable reminder systems triggered by dispensing and risk events; secure messaging that enables the rapid resolution of side effects and access barriers; and lightweight decision support for pharmacists conducting remote reviews, including deprescribing and interaction checks (Soyege et al., 2024). To realise their potential, these tools need workflow integration so that pharmacist time is concentrated where it yields the most significant marginal benefit (Alalawneh et al., 2022). Evidence from pragmatic trials and educational interventions shows that structured, protocolised contact, whether in person or remote, improves adherence and control of chronic conditions; therefore, home delivery programs should schedule short, standardised tele-consultations anchored to delivery cycles rather than relying on ad hoc outreach (Varas-Doval et al., 2021; Ayogu et al., 2023).

A further practice implication is systematic attention to medication beliefs. Routine screening for concerns related to necessity, such as balance, can identify patients at risk of intentional nonadherence. Pharmacists can then target myth-busting, side-effect management, and shared decision-making interventions that realign beliefs with clinical goals (Ahmed et al., 2021). Because home delivery reduces in-person pharmacy contact time, these conversations must be planned and documented, rather than left to chance at the doorstep (Manoliu-Hamwi et al., 2024). Finally, economic considerations should not be relegated solely to payers; pharmacists' involvement in HIV care has been shown to generate economic value, and similar logic suggests that proactive financial navigation, prior authorizations, co-pay assistance, and benefit optimization embedded within delivery models will protect continuity for high-cost therapies.

Implications for Policy

From a policy perspective, the core lesson is that logistics without clinical governance is a weak instrument for improving outcomes, and clinical governance without equitable logistics leaves large sections of the population underserved. Funding mechanisms should therefore explicitly bundle delivery reimbursement with pharmacist time for remote counselling and medication review. In markets where remuneration for home delivery is discretionary or uncoupled from clinical services, providers face perverse incentives to prioritise volume over engagement. A blended payment that recognises adherence-promoting clinical work is more likely to produce durable gains (Abu-Farha et al., 2022; Varas-Doval et al., 2021). Subsidies should target the structural determinants that prevent delivery from functioning effectively in rural areas, including support for cold-chain equipment, courier networks, and broadband expansion, as well as microgrants for community pharmacies to serve as distribution hubs under standardized protocols (Emadi et al., 2022). Given the demonstrated

economic value of pharmacist involvement in chronic infectious diseases, such as HIV, commissioners can justify such investments by avoiding complications and improving adherence to therapy, provided they require transparent reporting of adherence and clinical metrics (Ahmed et al., 2021).

Regulatory frameworks must keep pace with the realities of tele-enabled delivery. At a minimum, consistent national or regional standards should govern identity verification at delivery, documentation of counselling and consent, handling of missed deliveries, and chain of custody for temperature-sensitive products (Rezahi et al., 2021). Telepharmacy rules should clarify cross-jurisdictional practice, supervision, and delegation to ensure that remote pharmacist oversight is both lawful and auditable, thereby reducing the ambiguity that practitioners identify as a source of risk (Abu-Farha et al., 2022). For controlled substances and conditions such as opioid use disorder, regulations should facilitate, rather than frustrate, the creation of community-pharmacy pathways that include remote initiation, monitored home supply, and rapid escalation channels, while maintaining rigorous safeguards against diversion; achieving this balance will require standardised training, accreditation, and data-sharing agreements across prescribers, pharmacies, and digital platforms (Jarrett et al., 2023).

Policy should also support the translation of innovation into equitable routine practice. Grants and procurement frameworks can prioritise technologies with demonstrated usability for older adults and low-bandwidth environments, avoiding a drift towards solutions optimised for affluent urban users. Interoperability requirements can prevent the creation of data silos that fragment care, a barrier repeatedly cited in implementation research on adherence programmes (Muluneh et al., 2023; Soyege et al., 2024). Finally, research policy should incentivise studies that close the most consequential evidence gaps: pragmatic, multi-site comparisons of home delivery with and without structured telepharmacy; stratified analyses by urban–rural status; inclusion of patient-reported adherence and belief measures alongside PDC/MPR; and economic evaluations that capture both direct costs and system-level savings. Without such work, delivery risks are often treated as a universal solution when their actual value depends on design choices and local context (Varas-Doval et al., 2021; Manoliu-Hamwi et al., 2024). Home delivery can be a powerful accelerator of medication adherence and better health outcomes, but only as part of a deliberate architecture that integrates pharmacist expertise, digital support, and local realities (Rezahi et al., 2021). The former requires more emphasis on dependable infrastructure and common expert capacity due to its rural and urban locations; the latter requires more focus on relational continuity and the redesign of the workflow. There is a risk of practice leaders and policymakers succumbing to the urge to scale logistics without investing in the human and informational systems that render medications not only accessible but also acceptable.

Conclusion and Recommendations

This review concludes that pharmacy home delivery has a positive influence on medication adherence and health outcomes, particularly when integrated with pharmacist-led clinical services. A reliable supply reduces refill gaps and supports persistence, while structured remote counselling, medication reviews, and simple digital prompts convert logistical convenience into measurable improvements. However, disparities persist. Rural patients face sparse pharmacy infrastructure, long travel distances, and variable connectivity, conditions under which home delivery can have high marginal value but is fragile without dependable

last-mile logistics and low-bandwidth-tolerant telehealth. Urban patients benefit from proximity, yet risk attenuated outcomes when overcrowding and discontinuous follow-up erode counseling at the point of supply. Heterogeneity of designs, reliance on refill proxies, and self-selection into delivery channels temper the certainty of causation but do not negate the overall direction of the effect.

Practice should prioritise blended models that match intervention intensity to risk and context. In rural areas, tiered engagement that offers telephone-first counselling, SMS reminders, and scheduled teleclinics can offset connectivity and workforce constraints. Community pharmacies can act as distribution nodes if supported by clear handover protocols and shared documentation. In urban areas, programmes should redesign workflows to ensure that remote counselling and brief, structured check-ins are scheduled alongside each delivery cycle, preserving clinical dialogue despite throughput pressures. Across settings, routine screening for medication beliefs, proactive financial navigation for high-cost therapies, and cold-chain assurance are essential complements to delivery. Policy should align payment with outcomes by bundling reimbursement for home delivery with pharmacist time for remote counseling and medication review, thereby discouraging volume-only logistics. Targeted subsidies for rural courier networks, temperature-controlled equipment, and broadband expansion are warranted, as are interoperability standards that prevent data silos and support closed-loop communication between prescribers, pharmacies, and patients. Regulation should clarify the scope of telepharmacy, documentation, and cross-jurisdictional practice, and establish proportionate safeguards for controlled substances that enable access while preventing diversion.

Priorities include longitudinal and interventional studies that isolate the incremental effect of home delivery within speciality pathways, mixed-methods work that elicits patient and caregiver perspectives on usability and trust across geographies, and rigorous cost-effectiveness analyses that account for logistics, pharmacist time, and downstream utilisation. Studies should report both supply-based and patient-reported adherence, stratify results by urban-rural status and equity markers, and ensure transparency about co-interventions to strengthen causal interpretation.

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