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Research Article

Impact of AI-Based Medication Reminder Systems on Medication Adherence Among Patients with Chronic Diseases: A Community Pharmacy Perspective

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Abstract

Roughly half of patients with chronic diseases do not take their medicines as prescribed. In India, a nationally representative WHO-SAGE analysis found only about 51% of adults with non-communicable diseases are adherent. Community pharmacies are the most frequent point of contact for these patients, and artificial intelligence (AI) is increasingly being added to medication reminders through adaptive messaging, conversational agents, computer-vision dose confirmation and machine-learning risk prediction. This study examined, using published secondary data, (i) the effect of AI-based reminder and support systems on medication adherence in chronic disease; (ii) how that effect compares with conventional digital reminders and pharmacist-led care; and (iii) what the evidence implies for community pharmacy practice in India. A structured review of secondary data was undertaken in which sixteen documents were analysed—five primary studies, eight systematic, focused or narrative reviews and meta-analyses, one trial protocol and two policy/normative documents—together with five further AI trials extracted from those reviews; outcomes were tabulated as absolute adherence differences, odds ratios or standardised mean differences and synthesised narratively. Small AI trials reported large gains (e.g., plasma-confirmed adherence 100% vs 50% with an AI video-confirmation app; insulin adherence +32.7 percentage points with a voice assistant). The only meta-analysis of AI interventions found a moderate pooled effect (Hedges g = 0.41; 95% CI 0.17–0.65; 7 studies, 934 participants) but rated certainty as low, with a prediction interval crossing zero. The largest AI study (>33,000 patients) showed a modest 6.1% improvement. Conventional SMS reminders roughly doubled the odds of adherence (OR 2.11), whereas passive reminder devices and stand-alone apps produced little or no change, and pharmacist-led interventions improved adherence in 69% of trials. Overall, AI-based reminders are promising but not yet proven to outperform well-designed non-AI reminders. Their greatest value in community pharmacies is likely to come from combining risk prediction with pharmacist follow-up, rather than from automated reminders alone, and a rigorous Indian community pharmacy trial is needed.

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1. INTRODUCTION

Medication non-adherence is one of the main reasons why effective treatments fail in chronic disease. The World Health Organization's report *Adherence to Long-Term Therapies* estimated that adherence among patients with chronic diseases averages only about 50% in developed countries and is lower in developing countries; it reported adherence to antihypertensive medication of 27% in The Gambia, 43% in China and 51% in the United States (World Health Organization [WHO], 2003). Babel et al. (2021) note that good adherence has been associated with a 21% reduction in long-term mortality and that non-adherence carries large economic costs.

The problem is pronounced in India. A secondary analysis of WHO-SAGE Wave 2 data, covering 2,840 adults with one or more non-communicable diseases (NCDs) in six states, found that only 51.4% were adherent; among those with multimorbidity, adherence fell to 37.5% (Tolley et al., 2023). Since hypertension, diabetes and cardiovascular disease frequently co-exist, multimorbid patients—those most likely to be dispensed several medicines—are the least adherent.

Community pharmacies are a natural setting for adherence support. Patients return to them for repeated refills, and the pharmacist sees the full dispensing record. At the same time, reminder technology has moved beyond fixed alarms and text messages. *AI-based* reminder systems differ from conventional reminders in that they learn from data: they may predict which patients are likely to miss doses, adapt the timing and content of messages, hold a two-way conversation, or verify that a dose was actually taken through computer vision. Whether these added capabilities translate into better adherence than simpler reminders is the central question of this paper.

A primary community pharmacy trial requires prospective patient data. Before such a study is designed, it is useful to establish what the published evidence already shows. This paper therefore synthesises secondary data on AI-based reminder systems, compares them with conventional digital reminders and pharmacist-led care, and derives implications and a proposed workflow for Indian community pharmacies.

2. REVIEW OF LITERATURE

2.1 Conventional digital reminders

Text messaging is the most studied digital reminder. A meta-analysis of 16 randomised trials (2,742 patients) found that SMS reminders roughly doubled the odds of adherence (OR 2.11; 95% CI 1.52–2.93), equivalent to an increase from an assumed 50% baseline to 67.8%; the effect remained after adjustment for study quality (OR 1.67) and publication bias (OR 1.68), though heterogeneity was moderate (I^2 = 62%) (Thakkar et al., 2016).

Passive devices and stand-alone apps have performed less well. The REMIND trial randomised more than 37,000 patients in a large US pharmacy benefit population to a standard pillbox, a digital timer cap, a pill-bottle strip with toggles or no device; optimal adherence over 12 months was 15.1–16.3% in all arms with no significant difference from control (Choudhry et al., 2017). In the MedISAFE-BP trial (n = 411), the Medisafe app improved Morisky scale scores by only 0.4 points relative to control and did not lower blood pressure more than usual care (Morawski et al., 2018). In contrast, among medically underserved adults, one month of Medisafe use produced a moderate effect (Cohen's d = −0.52), with 43.3% of app users vs 9.7% of controls showing reliable improvement (Hartch et al., 2024).

2.2 Pharmacist-led interventions

The Cochrane review of 182 trials concluded that adherence interventions show inconsistent effects and that even the most effective ones did not produce large improvements; the more successful low-risk trials typically involved complex, multi-component interventions often delivered by pharmacists or other health professionals (Nieuwlaat et al., 2014). A 2025 systematic review of 26 pharmacist-led RCTs—12 of them conducted in community pharmacies—found a significant adherence benefit in 18 (69.2%), mostly through counselling and tailored interventions (Farhana et al., 2025). Notably, the review identified almost no trials in which pharmacists used SMS or app-based reminders, showing a gap between digital reminder research and pharmacy practice research.

2.3 AI-based systems

AI applications to adherence fall into four groups: (a) computer-vision dose confirmation, in which a smartphone camera verifies that the medicine was swallowed; (b) conversational agents, including chatbots and voice assistants; (c) predictive analytics, which use refill and profile data to identify patients at risk; and (d) smart dispensers and IoT devices. Three reviews have examined this field. Babel et al. (2021) described it as dominated by small, short studies. Reis et al. (2025) identified only seven eligible studies, four in real-world settings and all from the US private sector, and judged the evidence weak. Keller et al. (2026) conducted the first meta-analysis, discussed in Section 5.

2.4 RESEARCH GAP

No published randomised trial has tested an AI-based reminder system delivered through community pharmacies in India. Existing AI studies are small, concentrated in high-income settings and often compare the AI tool with minimal or no support rather than with an active conventional reminder. Evidence that would allow a community pharmacist to judge whether AI adds value over an SMS reminder or a counselling session is therefore missing.

3. OBJECTIVES

1. To summarise the reported effect of AI-based reminder and support systems on medication adherence among patients with chronic diseases.
2. To compare these effects with those of conventional digital reminders and pharmacist-led interventions.
3. To assess the quality and limitations of the evidence, including the reliability of secondary claims.
4. To propose an evidence-informed model for AI-assisted reminders in Indian community pharmacies.

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4. METHODOLOGY

4.1 Design

A structured review of secondary data with narrative synthesis. No patients were recruited and no primary data were collected.

4.2 Search and selection

Searches were run in October 2026 across PubMed/PMC, publisher databases (JAMA Network, Frontiers, Springer, Dove Press, Wiley), the Cochrane Library and WHO resources, using combinations of artificial intelligence, machine learning, chatbot, conversational agent, medication reminder, text message, mobile application, medication adherence, community pharmacy, pharmacist and India. Studies were included if they (a) reported adherence outcomes or adherence prevalence in adults with chronic disease, or (b) synthesised such evidence, or (c) set the regulatory or normative context for digital adherence tools in India. Only documents with a verifiable author, journal or issuing body and DOI or official source were used.

Table 1. Composition of the secondary evidence base

Type of document	Documents	n
Primary studies	Labovitz et al. (2017); Choudhry et al. (2017); Morawski et al. (2018); Hartch et al. (2024); Tolley et al. (2023)	5
Meta-analyses and systematic/focused reviews	Thakkar et al. (2016); Nieuwlaat et al. (2014); Reis et al. (2025); Keller et al. (2026); Farhana et al. (2025)	5
Narrative reviews	Babel et al. (2021); Moon & Walsh (2025); Al mazrouei et al. (2026)	3
Trial protocol	Zhai et al. (2019)	1
Policy / normative	WHO (2003); Digital Personal Data Protection Act, 2023	2
Total documents		**16**
Additional AI trials extracted from reviews	Bain et al. (2017); Gracey et al. (2018); Nayak et al. (2023); Koesmahargyo et al. (2020); Chaix et al. (2019)	5

Source: Compiled by the author. Trials in the last row were not accessed in full text; their data are taken from Reis et al. (2025), Babel et al. (2021), and Moon & Walsh (2025) and are cited accordingly.

4.3 Data extraction and analysis

For each study the design, population, sample size, duration, type of reminder or AI function, comparator, adherence measure and result were extracted. Where possible, results were expressed as the absolute difference in percentage points (pp) between intervention and comparator, computed by the author from reported group values. Pooled estimates were taken directly from the meta-analyses. Because adherence was measured in incompatible ways (pill count, plasma level, refill-based medication possession ratio, Morisky and ARMS scales), no new meta-analysis was attempted. Where a narrative review attributed a figure to a primary study, the figure was checked against the primary source when available.

5. RESULTS

5.1 The adherence problem in India

The Indian WHO-SAGE analysis (Tolley et al., 2023) provides the baseline against which any reminder system must be judged: 48.6% of adults with NCDs were non-adherent overall, 43.2% of those with a single condition and 62.5% of those with multimorbidity. A reminder system that targets multimorbid patients collecting several medicines from a pharmacy is therefore aimed at the group with the greatest need.

5.2 Effect of AI-based systems

Table 2 summarises the AI studies with reported adherence outcomes.

Table 2. AI-based adherence studies with reported outcomes

Study	AI function	Design / n	Adherence result
Labovitz et al. (2017), ischaemic stroke on anticoagulants	Smartphone computer-vision dose confirmation with reminders	RCT, n = 28 (27 analysed), 12 weeks	Plasma levels: 100% (15/15) vs 50% (6/12); pill count 97.2% vs 90.6%
Bain et al. (2017) *, schizophrenia	Same platform with facial recognition	Non-randomised, n = 75, 24 weeks	Pharmacokinetic adherence 89.7% vs 71.9% with modified DOT; no formal test reported
Nayak et al. (2023) *, type 2 diabetes on basal insulin	Voice-based conversational AI (Alexa)	RCT, n = 32, 8 weeks	82.9% vs 50.2%; difference 32.7 pp (95% CI 8.0–57.4), p = 0.01
Gracey et al. (2018) *	Predictive analytics selecting patients for live outreach calls	Randomised, AI arm n = 33,344	6.1% more likely adherent than control (p = 0.04); only 11.7% of the AI arm actually received an intervention
Chaix et al. (2019) †, breast cancer	Chatbot ('Vik') with reminders	Observational	Compliance improved by > 20% among patients who engaged more with the chatbot
Koesmahargyo et al. (2020) *	XGBoost prediction of missed doses	Observational, n = 4,182	Prediction only: AUC 0.83–0.87; no effect on adherence tested

*As reported in Reis et al. (2025). †As reported in Babel et al. (2021) and Moon & Walsh (2025). pp = percentage points; DOT = directly observed therapy.

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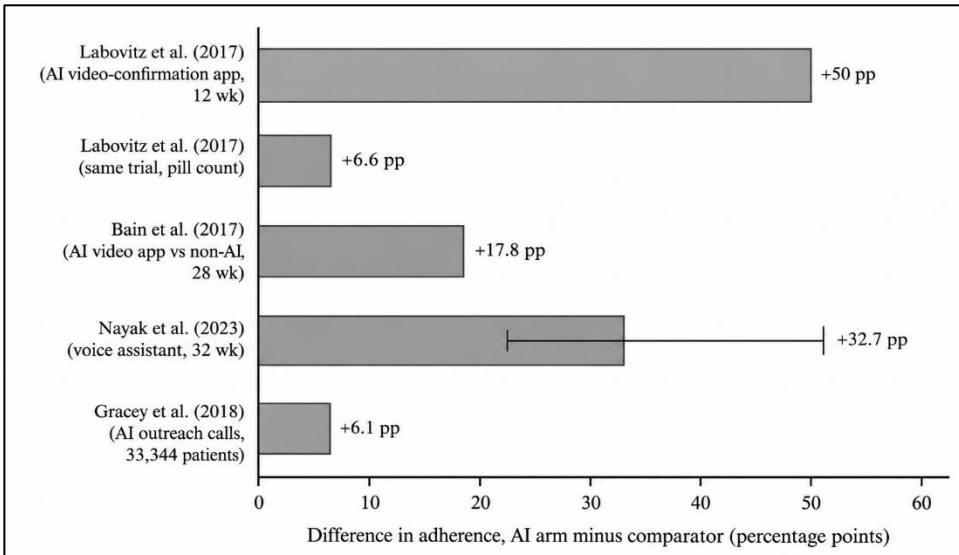

Figure 1. Absolute adherence differences reported in AI-based studies.

Source: Prepared by the author from the studies in Table 2. Error bars show the 95% CI where reported.

Two patterns stand out. First, effect size is inversely related to study size: the three studies with fewer than 80 participants report gains of 18–50 pp, while the trial with more than 33,000 patients reports 6.1%. Second, the measure matters. In the same Labovitz trial, the difference was 50 pp by plasma levels but only 6.6 pp by pill count, because the control group's pill counts were already high (90.6%).

The meta-analysis by Keller et al. (2026) pooled seven studies with 934 participants and found a moderate effect in favour of AI-enabled interventions (Hedges g = 0.41; 95% CI 0.17–0.65; I^2 = 58%). However, the 95% prediction interval (−0.22 to 1.04) includes no effect, the estimate weakened when high-risk-of-bias studies were excluded, and no clear downstream clinical benefit was established. The authors rated the certainty of evidence as low for adherence and very low for clinical outcomes, and cautioned that prediction accuracy should not be read as intervention effectiveness.

5.3 Comparison with conventional reminders and pharmacist-led care

Table 3. Comparative evidence: conventional digital reminders and pharmacist-led interventions

Study	Intervention	Result
Thakkar et al. (2016) — meta-analysis, 16 RCTs, 2,742 patients	SMS reminders	OR 2.11 (95% CI 1.52–2.93); ≈ 50% → 67.8% adherence
Choudhry et al. (2017) — REMIND RCT, 36,739 analysed	Pillbox, timer cap, toggle strip	Optimal adherence 15.1–16.3% in all arms; no difference from control
Morawski et al. (2018) — MedISAFE-BP RCT, n = 411	Medisafe app (reminders, reports)	MMAS difference 0.4 points; no difference in systolic BP (−10.6 vs −10.1 mm Hg)
Hartch et al. (2024) — RCT, n = 65, underserved adults	Medisafe app, 1 month	ARMS change −4.0 vs −1.0 (d = −0.52); reliable improvement 43.3% vs 9.7%
Farhana et al. (2025) — systematic review, 26 RCTs (12 community pharmacy)	Pharmacist counselling / tailored care	Significant benefit in 18 of 26 trials (69.2%)
Nieuwlaat et al. (2014) — Cochrane, 182 RCTs	Mixed adherence interventions	Inconsistent effects; successful ones complex and often pharmacist-delivered

Source: Compiled by the author.

Placed side by side, the evidence suggests that *engagement*, rather than technology, is the active ingredient. Interventions that demand or invite a response—SMS that patients read, pharmacist counselling, video confirmation of each dose, a conversation with a voice assistant—tend to work; passive devices and apps that patients can ignore tend not to. AI systems that include two-way interaction appear to belong to the first group, but there is no head-to-head trial showing that they outperform a well-designed SMS or pharmacist programme.

5.4 Reliability of secondary claims

Checking claims against primary sources revealed errors in the secondary literature. One 2026 narrative review attributes to Choudhry et al. (2017) a 27% reduction in missed doses with AI-monitored smart dispensers, and describes the Thakkar et al. (2016) meta-analysis as evidence for *conversational AI* (AI

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mazrouei et al., 2026). In fact, the REMIND trial tested simple, non-AI devices and found no effect, and the Thakkar meta-analysis concerned conventional text messages. Reis et al. (2025) also noted an inconsistency between the 6.7% stated in their abstract and the 6.1% reported in their results for the Gracey trial. These examples show that figures on AI and adherence circulating in reviews must be verified against primary studies before they inform practice or policy.

6. DISCUSSION

The evidence supports a cautious conclusion. AI-based reminder systems can improve adherence, and some small trials report striking effects, but the overall certainty is low. Three reasons explain the gap between promise and proof. First, **most AI trials are small and short**, and small trials tend to overestimate effects; the one very large trial found a modest 6.1% gain. Second, **comparators are often weak**: AI tools are compared with no support or usual care, not with an active SMS or pharmacist programme, so it is unclear whether the AI component, or simply the extra contact, produces the benefit. Reis et al. (2025) made a similar point, suggesting that part of the observed benefit reflects AI being added to existing monitoring such as call-centre surveillance. Third, **reach is limited**: in the Gracey trial only 11.7% of the AI arm received an intervention, illustrating that identifying at-risk patients is of no value unless someone acts on the prediction.

For community pharmacies, the most promising role of AI is therefore not to replace the pharmacist's reminder, but to direct the pharmacist's limited time. A risk model built on refill gaps can identify which patients need a call or counselling session, while low-cost adaptive SMS or WhatsApp messages handle routine reminders. This combines the two components with the strongest evidence—text reminders (Thakkar et al., 2016) and pharmacist-led care (Farhana et al., 2025)—with the predictive capacity that AI adds. Figure 2 sets out a workflow on this basis.

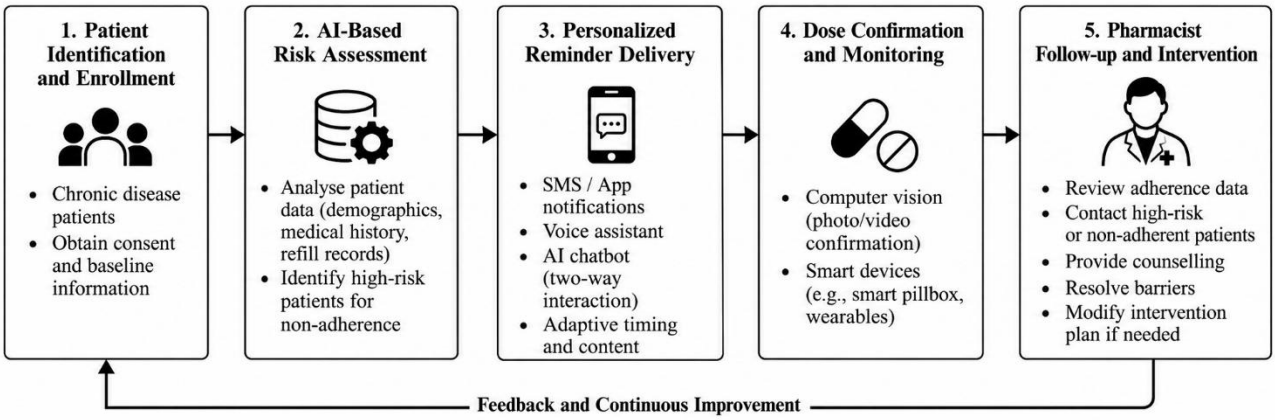

Figure 2. Proposed workflow for AI-assisted reminders in Indian community pharmacies.

Source: Developed by the author from the evidence reviewed. PDC = proportion of days covered; MMAS = Morisky Medication Adherence Scale; IVR = interactive voice response.

Indian conditions shape how such a system should be designed. Many patients use basic phones, prefer regional languages and may share a handset, so reminders should be offered by SMS or interactive voice in the patient's language as well as by app. The WHO-SAGE finding that multimorbid patients are least adherent (Tolley et al., 2023) suggests prioritising patients with several chronic prescriptions. Finally, adherence data are personal health data. The Digital Personal Data Protection Act, 2023 requires lawful, consent-based processing of personal data, so pharmacies would need clear consent at enrolment, data minimisation and secure storage, with the pharmacist retaining responsibility for clinical decisions.

7. Recommendations

1. **For practice:** Community pharmacies adopting AI tools should use them primarily for risk stratification and adaptive messaging, with every alert reviewed by a pharmacist. Passive devices or app downloads without follow-up should not be relied upon.
2. **For research:** A pragmatic, cluster-randomised trial in Indian community pharmacies should compare (a) usual care, (b) conventional SMS reminders and (c) AI-adaptive reminders with pharmacist follow-up, for at least 12 months, using refill-based PDC as the primary outcome and blood pressure or HbA1c as clinical outcomes.
3. **For evidence users:** Figures on AI and adherence quoted in secondary reviews should be checked against primary studies before being cited.
4. **For policy:** Pharmacy councils and regulators should develop guidance on consent, data protection and accountability for AI-assisted adherence services in line with the DPDP Act, 2023.
5. **For equity:** Systems should include SMS/IVR options in regional languages so that older, rural and low-income patients—often the least adherent—are not excluded.

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8. Limitations

This review relies on published secondary data. Five AI trials were not accessed in full text and their results are reported as summarised in peer-reviewed reviews. Adherence measures differed across studies, preventing a new pooled analysis. Almost all AI evidence comes from high-income settings, particularly the US, and no study was conducted in an Indian community pharmacy; the proposed workflow is therefore a model for testing, not a validated intervention. The search was limited to English-language sources.

9. CONCLUSION

AI-based medication reminder systems show promise for improving adherence among patients with chronic diseases, but the evidence remains low in certainty and has not shown that AI outperforms simpler reminders or pharmacist-led care. In Indian community pharmacies, where about half of patients with chronic diseases are non-adherent, AI is most likely to add value by helping pharmacists identify and reach the patients who need support most, rather than by sending automated reminders alone. A rigorous community pharmacy-based trial in India is the necessary next step.

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