AI-Integrated Medication Adherence and Telecare System

[Jophina Johnson], [Princy Subhiksha B]

[Department of Computer Science with Data Analytics], [Dr.N.G.P Arts and Science College], [Coimbatore,Tamil Nadu]

ABSTRACT

Missed doses are a common problem in both long-term and short-term treatment. Patients forget, struggle with complicated schedules, lack someone to help them at home, or find it hard to reach a clinician for follow-up. This paper describes a medication adherence and telecare system that puts several of these supports in one place: personalised medication schedules, reminders, patient dose-response recording, caregiver monitoring, voice-assisted interaction, and remote video consultation. Patients of any age can use it, and authorised caregivers can see adherence records and act on missed-dose alerts. Artificial intelligence plays a supporting role only, helping with conversational assistance, reminder personalisation and summaries of adherence patterns. It does not diagnose, prescribe or change medication. The paper sets out the requirements, modular architecture, data flow and privacy considerations, along with a plan for evaluation. No implementation or user-testing results are available yet, so we make no claim about clinical benefit or measured performance. Usability testing, functional verification, a security review and an ethically approved study are needed before anything can be said about real-world effectiveness.

Keywords: Medication Adherence, Telecare, mHealth, Artificial Intelligence, Caregiver Monitoring, Video Consultation

1. INTRODUCTION

Medication adherence describes how closely a person's medication-taking follows the treatment plan agreed with their clinician. Many things get in the way: forgetfulness, complicated regimens, side effects, cost, limited health literacy and difficulty reaching care. For people with long-term conditions, irregular medication use can make the illness harder to manage and raise the need for extra healthcare support. A review of studies from India found that adherence interventions often combine patient education, follow-up and reminders, and called for stronger, longer-term evaluation [1].

Mobile and web tools make it easy to send reminders and keep a record of the doses a patient reports, and telehealth lets patients reach a professional without travelling. In practice, though, reminders, caregiver messages and remote consultations usually sit in separate apps. Bringing them together could save patients and caregivers a good deal of effort, as long as the result is accessible, secure and built around how they actually use it.

This paper presents a proposed AI-integrated medication adherence and telecare system. It covers medication schedule management, timely notifications, a simple Yes/No dose response, caregiver access to adherence information the patient has shared, voice-assisted interaction and video consultation. The AI features are optional aids, not clinical decision-makers. The contribution is a system design and an evaluation framework. We do not claim that the system has been deployed or that it improves adherence.

1.1 Related Work

Digital support for medication adherence has been studied in several forms, including mobile apps, text messages, telehealth and self-management tools. A systematic review of chronic disease in India found that education and regular follow-up looked promising, whereas reminders on their own had weaker evidence and seemed to work better alongside other support [1]. A digital tool therefore cannot replace patient education or clinician involvement. Reviews of eHealth interventions [2], adherence apps [4] and telemedicine for particular patient groups [3] point the same way: reminders work best when they are connected to communication and follow-up, not left as stand-alone alarms.

What sets this design apart is the combination of scheduling, patient confirmation, caregiver visibility, voice interaction and remote consultation in a single workflow. This is a proposed integration and we do not claim it is better than existing products. Showing that would take a full systematic review and a direct comparison.

1.2 Problem Statement and Objectives

Keeping to a medication routine is hard when schedules are complex or when reminders, dose records and consultation tools are kept apart. A reminder cannot confirm that a dose was taken, and a patient's own confirmation is not proof that the medicine was swallowed. The aim is an accessible, privacy-aware platform that sends reminders, records what patients report, tells authorised caregivers when follow-up may be needed, and supports remote communication, all without making unsafe clinical decisions. The objectives are:

- To provide a configurable medication schedule with dose times and reminder notifications.
- To allow patients or authorised helpers to record a Yes/No response for each scheduled dose.
- To present adherence history and missed-response indicators to authorised caregivers.
- To provide voice-assisted navigation and reminders for users who may have difficulty interacting with a screen.
- To support remote video consultation between a patient and an authorised healthcare professional.
- To explore safe, explainable AI support for reminder personalisation and summaries, subject to validation and user consent.
- To define a practical evaluation plan covering functionality, usability, privacy, security, and reliability.

2. METHODOLOGY AND IMPLEMENTATION

2.1 Development Approach

We propose a modular, iterative approach. The first step is to gather requirements from intended users and healthcare stakeholders. Low-fidelity screens can then be reviewed for accessibility before the application, backend, database, notification workflow and consultation link are built. Each module is tested on its own and then in end-to-end scenarios. The AI component comes last: it is added only once its purpose, input data, failure modes and human oversight have been defined.

2.2 User Roles

Role	Main capabilities	Access boundary
Patient	View schedule, receive reminders, respond Yes/No, request help, join consultation	Own medication and adherence information
Caregiver	View authorised adherence records, receive missed-response alerts, assist with schedules when permitted	Only patients who have granted access
Healthcare professional	Review shared information and conduct remote consultation	Minimum necessary information for the care relationship
System administrator	Maintain service availability, roles, audit logs, and technical configuration	No routine access to clinical content unless explicitly authorised

Table 1. User roles and access boundaries.

2.3 Core Modules

Medication schedule manager. Stores medication name, prescribed dosage instructions, frequency, start/end dates where applicable, and reminder times entered or confirmed by an authorised user. The system should not independently create or change a prescription.

Reminder and notification service. Generates scheduled notifications through supported channels. Delivery status should be logged where the platform provides it, while acknowledging that notification delivery does not prove the patient saw the reminder.

Dose-response recorder. Displays a simple Yes/No prompt and records the patient's response with a timestamp. A missing response is represented as unknown or unconfirmed, not automatically as a missed dose.

Caregiver dashboard. Shows authorised schedules, response history, and outstanding prompts. Alerts should be configurable to reduce unnecessary notifications and protect patient privacy.

Voice assistant. Supports hands-free navigation, reading reminders aloud, and simple commands. Identity checks and confirmation steps are needed before revealing sensitive information or changing schedules.

Telecare/video consultation. Provides a secure route to a remote consultation using a suitable video service. Availability, consent, and contingency instructions should be clear.

AI support layer. May generate plain-language summaries, help users navigate features, or suggest reminder preferences based on user-approved patterns. AI output should be clearly labelled and should not diagnose, prescribe, or alter medication.

Security and audit module. Manages authentication, role-based permissions, consent, encrypted communication, access logs, backup, and account recovery.

2.4 System Architecture

The architecture is a logical design. A final build could use Flutter or React Native for the client, a Python or Node.js backend, a managed database, a notification service and a WebRTC-compatible video service. These are candidates, not confirmed choices.

PATIENT APP / CAREGIVER DASHBOARD / CLINICIAN VIEW
Authentication • Consent • Role-based access • API layer
Medication schedule • Reminder engine • Dose-response log • Alerts
AI support (optional) • Voice interface • Video consultation integration
Encrypted database • Audit logs • Backup • Monitoring

Figure 1. Logical architecture of the proposed system. The layers represent intended responsibilities; integration and security controls must be verified during implementation.

2.5 Typical Workflow

1. An authorised user enters the medication schedule according to the clinician's instructions or confirms a schedule supplied through an approved workflow.
2. The reminder service checks the schedule and sends a notification at the configured time.
3. The patient records Yes, No, or no response. The interface should explain that the response is self-reported.
4. If the response remains unconfirmed beyond a configurable interval, the system may notify an authorised caregiver according to consent and notification settings.
5. The patient or caregiver can request a telecare consultation when support is needed.
6. The dashboard displays a history of recorded responses and system events, with access limited to authorised roles.

2.6 Functional Requirements

ID	**Requirement**
FR1	Users can authenticate and sign out securely.
FR2	Authorised users can create, review, and update medication schedule records within their permissions.
FR3	The system can issue reminders at configured times on supported devices.
FR4	Patients can record a Yes/No response for a reminder.
FR5	The system stores response timestamps and distinguishes No from no response.
FR6	Authorised caregivers can view shared adherence records and receive configured alerts.

ID	Requirement
FR7	Users can access voice-assisted navigation where supported.
FR8	Users can initiate or join an authorised video consultation.
FR9	Users can review and revoke data-sharing consent where applicable.
FR10	Access to sensitive records is logged and protected by role-based permissions.

Table 2. Functional requirements.

2.7 Non-Functional Requirements

- **Usability:** clear language, readable text, accessible controls, and a low-effort reminder response.
- **Reliability:** resilient scheduling, duplicate-notification protection, error logging, and recovery from network interruption.
- **Security:** secure authentication, least-privilege access, encryption in transit and at rest where supported, and regular security review.
- **Privacy:** data minimisation, informed consent, clear retention rules, and appropriate handling of sensitive health information.
- **Interoperability:** documented interfaces and consistent timestamps; healthcare data standards may be considered if integration is required.
- **Safety:** no autonomous prescription changes, diagnosis, or advice to double a dose; uncertain situations should direct users to clinician-approved instructions or professional help.

2.8 Data Model

Entity	Example fields	Purpose
User	user_id, role, contact, consent_status	Identity and permissions
MedicationSchedule	schedule_id, patient_id, medication_label, instructions, time, active_period	Reminder configuration
DoseResponse	response_id, schedule_id, scheduled_time, response, response_time	Patient-reported adherence history
CaregiverLink	patient_id, caregiver_id, permission_scope, consent_date	Authorised sharing
NotificationLog	notification_id, recipient_id, event_time, delivery_status	Troubleshooting and audit
Consultation	consultation_id, participants, scheduled_time, status	Consultation coordination; avoid unnecessary recording

Table 3. Proposed data model.

2.9 AI Integration and Safety

Here, "AI-integrated" means a supporting layer, not a validated clinical AI model. Three features are being considered: natural-language help with using the app, reminder suggestions based on a user's past interactions and under their control, and short summaries of recorded responses for the patient or an authorised caregiver. Before any of these is used, it needs to be checked for accuracy, accessibility, bias, privacy and how it behaves when it fails.

Recorded facts and AI-generated summaries must be kept apart. The system must not conclude that a dose was swallowed just because a button was pressed, judge whether a medication is appropriate, suggest a dose change, or treat a missed response as an emergency without a validated, approved escalation protocol. Medication instructions stay with the prescribing professional, and users can correct records and report errors.

2.10 Ethical, Privacy, and Security Considerations

Medication schedules and adherence records are sensitive health information. The system should collect only what it needs, tell users how it will be used, and let patients understand and control what their caregivers can see. Authentication, role-based access, encrypted transport, secure storage, audit trails, backups, retention limits and an incident-response process all need to be planned. Video consultations should use a secure provider and should not be recorded by default.

Users differ in age, digital skill, language and accessibility needs, and the design has to allow for that. Spoken output should not read out private information in public unless the user confirms. Caregiver alerts should be adjustable and proportionate. Any study with patients or identifiable health data will need ethics review and must follow institutional and legal requirements.

3. RESULTS AND FINDINGS

No implementation or testing data were available for this manuscript, so this section sets out an evaluation plan and does not report completed experiments. Before any study with patients, the team must obtain institutional ethics approval and informed consent, and complete a data-protection review.

Evaluation area	Suggested measure	Evidence to record
Functional correctness	Pass/fail for each requirement	Test cases, defects, retest outcomes
Reminder reliability	Correctly scheduled and logged reminders / reminders tested	Device, OS, network, timestamp, delivery status
Response recording	Correct storage of Yes, No, and no response states	Expected versus observed database records
Usability	Task completion, time on task, and a suitable usability questionnaire	Participant profile, consent, anonymised responses
Accessibility	Completion of key tasks using larger text, screen reader, or voice features	Observed barriers and fixes
Security and privacy	Permission tests, threat review, and vulnerability assessment	Findings, severity, remediation
AI support quality	Human-rated correctness and unsafe-output rate on a defined test set	Test protocol, dataset provenance, review criteria
Clinical/adherence impact	A pre-specified validated adherence measure in an approved study	Protocol, sample size rationale, analysis, limitations

Table 4. Evaluation plan.

[PLACEHOLDER — complete after implementation and testing.] Report the implemented platform and version, test environment, number and type of test cases, observed outcomes, usability sample and protocol (if applicable), and any security or accessibility findings. Present actual measured values with units and denominators. If no user study has been conducted, state that the current work is a design/prototype and limit the discussion to verified functional tests. Do not insert unmeasured success rates, adherence improvements, satisfaction scores, clinical outcomes, or AI accuracy figures.

4. CONCLUSION AND FUTURE WORK

This paper proposed a medication adherence and telecare system that brings scheduling, reminders, patient-reported dose responses, authorised caregiver monitoring, voice interaction and remote consultation onto one platform. The design puts accessibility, privacy, clear role boundaries and human oversight first, and treats AI as an optional aid, not a substitute for professional judgement. The architecture and evaluation plan give a starting point for implementation. Usability, reliability, security and any effect on adherence still have to be shown through documented testing and approved studies before clinical benefit can be claimed.

The main limitations are these. The paper describes a proposed system, and no implementation details or empirical results are available yet. A patient's response is self-reported and cannot verify that the medicine was taken. Reminder delivery depends on device settings, battery, network and operating-system restrictions. AI-generated text can be incomplete or wrong and needs validation. Usability, clinical value, scalability, cost and long-term effect on adherence are untested. Finally, linking with electronic health records, pharmacies or clinical workflows would need further technical, governance and interoperability work.

Next steps are to build and validate the core reminder and response workflow, run accessibility-focused usability tests and complete a security assessment. A later study could then test feasibility and adherence outcomes using a pre-registered protocol and a validated measure. Other directions include multilingual voice interaction, clinician-approved escalation pathways, integration with existing health systems, and AI-assisted summaries checked against expert-reviewed references. Patient feedback, clinical governance and evidence of safety should guide any expansion.

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