MediMate: A Design Thinking–Based Medicine Reminder and Adherence Tracker with A Missed-Dose Care Loop and Caregiver Support

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***Abstract*—Missed and mistimed doses are a common obstacle to effective treatment, and the usual aids (memory, handwritten notes and separate phone alarms) do not record whether a dose was actually taken. This paper presents MediMate, a web application that brings medicine entry, dose scheduling, reminder notifications, taken/missed/pending dose recording, medication history and adherence summaries into one workflow. The system was developed through the five stages of Design Thinking: Empathy, Define, Ideate, Prototype and Test. Beyond the core modules, the prototype includes a Missed-Dose Care Loop that moves from reminder to grace period, status check, optional caregiver alert and follow-up; separate patient and caregiver dashboards; a prescription-image scanner whose extracted fields must be reviewed by the user before saving; and a voice interface for hands-free confirmation. The modules were checked with positive and negative functional test cases covering registration, login, medicine management, scheduling, reminders, dose tracking, history and the dashboard. This paper is a design and prototype description. It is not a clinical trial, and we do not claim any measured improvement in adherence. Recorded dose status is treated as self-reported rather than verified intake, and the system does not recommend or change doses.**

***Index Terms*—Adherence tracking, caregiver support, Design Thinking, medicine reminder, mobile health, web application.**

I. INTRODUCTION

Taking medicines at the prescribed time and in the prescribed way is central to the success of a treatment. The World Health Organization describes poor adherence to long-term therapies as a major problem that reduces the benefit of treatment [1]. In daily life, however, a person may have several medicines with different doses and timings, and remembering all of them depends on memory, handwritten notes, paper prescriptions, phone alarms or calendars. These methods are scattered, and none of them keeps a dependable record of what was actually taken.

Mobile applications are one response to this problem. Systematic reviews have examined whether adherence apps and reminder-based interventions work [2], [3], and the evidence base differs by population, condition and design. Most reminder apps stop at the alarm. They do not help the user check a dose afterwards, review a pattern of missed doses, or let a trusted person know when help may be needed.

We built MediMate to put the main steps of medicine management in one place: adding medicines, setting schedules, receiving reminders, recording whether each dose was taken or missed, reviewing history and seeing a summary. The project followed the Design Thinking approach [4], starting from the difficulties users face and moving through problem definition, idea generation, prototyping and testing.

The main contributions are:

- A single workflow that links medicine entry, scheduling, reminders, dose-status recording, history and adherence summaries;
- A Missed-Dose Care Loop in which an unconfirmed dose leads to a status check and, where the user has allowed it, a caregiver alert and follow-up;
- A prescription-image scanner that fills the medicine form but requires human review before anything is saved;
- Patient and caregiver dashboards and a voice interface aimed at older users and those who find typing difficult; and

- A testing plan that covers valid and invalid inputs for each module.

We state the scope plainly. This is a design and prototype paper. We report no clinical outcomes and no measured change in adherence, and the percentages shown in the prototype screens are illustrative. Section II reviews related work, Section III describes the Design Thinking process, Section IV presents the system, Section V covers safety and privacy, Section VI describes testing, and Sections VII and VIII discuss limits and future work.

II. RELATED WORK

A. Mobile reminders and adherence

Armitage et al. reviewed randomised controlled trials of apps designed to support medication adherence and combined them in a meta-analysis [2]. Ng et al. reviewed the impact of mobile applications on adherence more broadly [3]. Individual trials have studied a personalised medication management platform [5], interactive reminders [6] and a smartphone reminder application used by emerging adults for a short course of treatment [7], and a later review and meta-analysis covers mobile health interventions for adherence [8]. These studies differ in population, condition, intervention and outcome measure, so we do not carry any reported effect size over to MediMate. What they do support is the design premise that timely reminders and some forms of feedback are worth building into a medication tool.

B. Recording and reviewing doses

Adherence tools differ in how they record intake. Some only notify; others let the user mark a dose as taken, missed or pending and keep a history that can be reviewed or discussed with a clinician. A known weakness is that the record is only as good as the user's updates, since a user who forgets to log a dose produces a record that does not match reality. MediMate therefore keeps the recording step to a single action and also accepts confirmation by voice.

C. Voice and assisted interaction

Voice and chat assistants reduce the need to type and navigate menus [9], and hybrid care platforms combine digital tools with human support [10]. MediMate borrows both ideas in a modest way: a short-spoken exchange for confirming a dose, and a caregiver view that keeps a person in the loop. The system is intended to support the care relationship and not to replace it.

III. DESIGN THINKING METHODOLOGY

Design Thinking is a human-centred method that starts from users' needs and moves through a sequence of stages [4]. We used five of them, as follows.

A. Empathy

The Empathy stage looked at people who take medicines regularly, elderly users, patients on long-term treatment and caregivers who help with schedules. A ten-question questionnaire was prepared. It asks whether users forget doses, how they currently remember their schedule, whether several medicines with different timings are hard to manage, whether notifications, dose recording, history and customisable reminder times would help, and what difficulties and desired features users have. An empathy map organised what users might say, do, think and feel, together with their pains and gains. Responses to the questionnaire are not analysed in this paper, so the problem statement below rests on the empathy map and the literature, not on survey statistics.

B. Define

The core problem was defined as the lack of a convenient, organised way to manage medication schedules and record adherence. Users forget doses, confuse timings when they have several medicines, and have no clear record of their history. The success criteria were: a simple interface; reminders shown at the times the user sets, subject to device settings and notification permissions; accurate dose and history records; protection of personal medication data; and validation of user input. A further criterion is a boundary: the application must not replace professional medical advice or change prescribed instructions.

C. Ideate

Brainstorming produced ideas such as a medicine list, a schedule view, timely alerts, daily summaries, a record of completed and missed doses, adherence reports, caregiver support, voice prompts and a prescription scanner. Ideas were judged on usability, usefulness, feasibility, reliability, security and privacy.

The selected set was combined into one application concept in which the steps run from entering a medicine to receiving a reminder and then recording the outcome.

D. Prototype and Test

The prototype consists of screens for the home page, medicine entry and scheduling, the dashboard, the care loop and the voice interaction (Figs. 2–5). It was then tested module by module and as a connected workflow, as described in Section VI.

IV. SYSTEM DESIGN

A. Architecture

Fig. 1 shows the layered design. The user-experience layer holds the patient web and mobile interface, the caregiver dashboard and the voice interface. The application-services layer contains authentication, the medicine schedule, the reminder engine and the adherence tracker.

An intelligence layer handles OCR extraction, voice-intent handling and schedule interpretation. The data and notifications layer holds medicine records, dose history, the alert service and caregiver synchronisation. Privacy, access control and human verification apply across all layers.

The front end is written in HTML, CSS and JavaScript. After login the browser keeps a session token and shows the dashboard only when a valid token is present; an invalid token is removed and the user is returned to the login page. The report names Flask, a lightweight Python web framework, as the intended back end for routing, form handling and database communication. [Authors: state the database and notification mechanism actually used.]

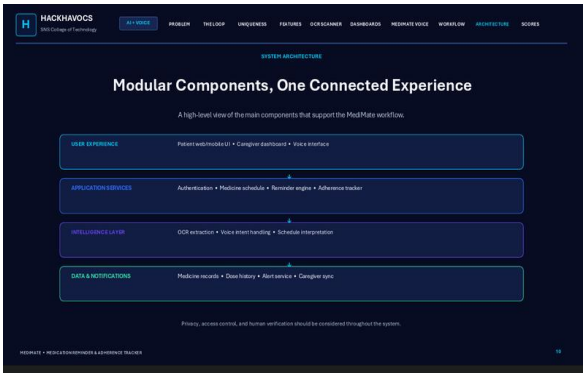

Fig. 1. Layered architecture of MediMate.

B. Core modules

Table I lists the modules and what each one does.

TABLE I MEDIMATE MODULES

Module	Function
Registration and login	Creates an account from name, email, password and confirmation; authenticates users; ends the session on logout.
Medicine management	Stores name, dosage, frequency, start and end dates and instructions; allows edit and removal.
Scheduling	Organises dose times and shows the medicines due on a given day.
Reminders	Notifies the user at the configured time, subject to device permissions and operating-system limits.
Dose tracking	Records each scheduled dose as taken, missed or pending, tied to the medicine and time.
History	Keeps earlier schedules and dose-status records for review.
Adherence summary	Summarises recorded doses over a chosen period, such as a day or a week.
Dashboards	Patient view of today's doses; caregiver view of status and alerts.

C. Adherence summary

For a chosen period, the adherence figure is computed from the user's own records as

$$A = N\text{taken} / (N\text{taken} + N\text{missed}) \times 100\% \quad (1)$$

where Ntaken and Nmissed are the doses recorded as taken and missed, and doses still pending are left out. The figure describes what was recorded. It is not a clinical measure and does not show that treatment was followed correctly. The value of 92% on the prototype dashboard (Fig. 3) is an example for the screen design only.

D. Prescription scanner

Typing every medicine is tedious for some users. The scanner takes an image of a paper prescription, extracts text by OCR, and proposes a table of medicine, strength, frequency and status. Each row is shown as "Review", and nothing is saved until the user verifies and confirms it (Fig. 2). Human review is a

deliberate part of the design, because OCR can misread a drug name or a dose and the consequences of a wrong schedule are real.

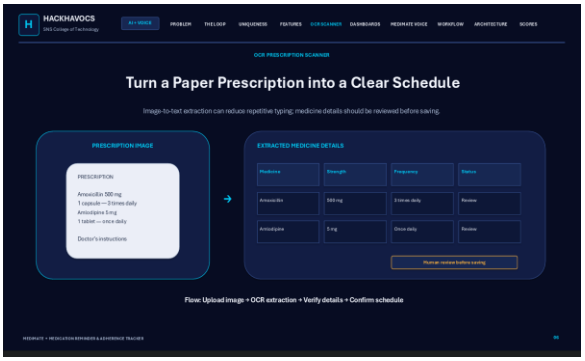

Fig. 2. Prescription scanner: upload, OCR extraction, verification and confirmation.

E. Patient and caregiver dashboards

The patient dashboard shows today's medicines with their status (taken or upcoming) and a progress bar for the day. The caregiver dashboard shows patient status, last confirmation time, any missed-dose alert and weekly adherence (Fig. 3). Caregiver access is intended to work only with the patient's permission.

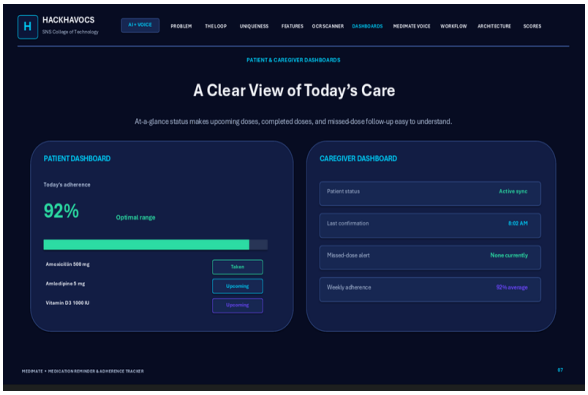

Fig. 3. Patient and caregiver dashboards (prototype screen; values are illustrative).

F. Missed-Dose Care Loop

When a dose is not confirmed, the system does not simply count it as missed. It follows five steps (Fig. 4):

1) a reminder is sent at the scheduled dose time;
2) a grace period waits for the user's confirmation;
3) the status is checked and shown as taken, unconfirmed or unknown;
4) an alert goes to the caregiver if one is needed and permitted; and
5) the schedule and routine are reviewed in a follow-up.

The stated goal is timely awareness, clear status and supportive follow-up, not blame. [Authors: state the length of the grace period used.]

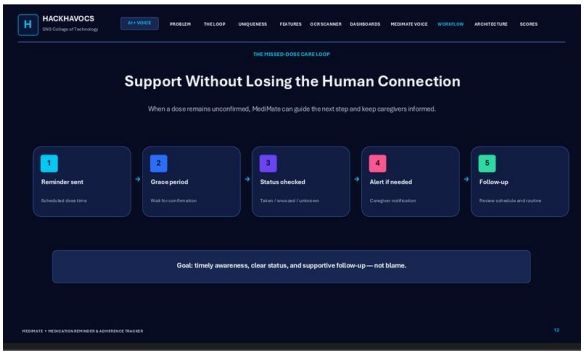

Fig. 4. The Missed-Dose Care Loop.

G. Voice interaction

For users who find typing hard, the voice interface reads out a reminder, such as "It's time for your Amlodipine 5 mg," and waits for a short reply. Example commands include "I've taken it," "Remind me later" and "What's next?" The flow is listened, interpret, respond and update (Fig. 5). Prompts are kept short and the system confirms what it understood before it logs an action.

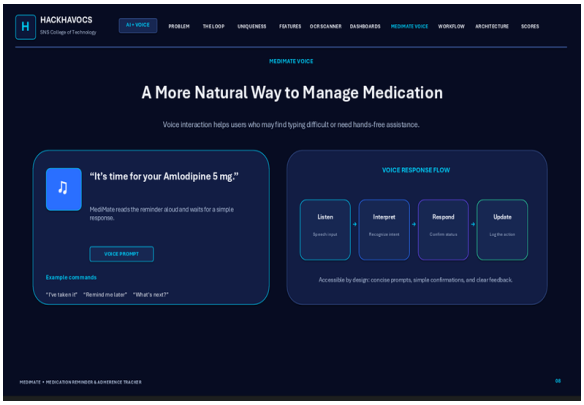

Fig. 5. Voice interaction flow.

V. SAFETY, PRIVACY AND SCOPE

Recorded is not verified. A "taken" entry means the user said so. The system does not observe intake, and the summaries it produces must not be read as proof that treatment was followed or as a diagnosis.

No clinical advice. Schedules must be entered according to the instructions of the user's healthcare professional. MediMate does not suggest, change or interpret doses.

Privacy. The application holds personal data: account details, medicine names, doses, schedules and dose history. It therefore needs authentication, role-appropriate access, input validation, secure storage and backups.

Testing checks that users reach only their own records and that protected pages cannot be opened without login. Caregivers see a patient's data only with the patient's permission.

Reminder reliability. Notification delivery depends on device settings, permissions and operating-system restrictions. A reminder that does not arrive is a safety issue as well as a usability one, which is why reminder behaviour is a distinct test area.

VI. TESTING

Testing used predefined inputs, and the actual output was compared with the expected result and marked Pass or Fail. Each module was tested alone and then in the full flow from registration to the adherence summary. Both positive tests (valid data should work) and negative tests (invalid data should be refused with a clear message) were used. Table II summarises the cases.

TABLE II FUNCTIONAL TEST CASES

Module	Positive case	Negative case	Result
Registration	Valid name, email, password and confirmation create an account	Empty fields, bad email format, weak password, mismatch, duplicate email	[ ]
Login	Correct credentials open the dashboard; logout ends session	Wrong password, unregistered email, empty fields, direct access to protected page	[ ]
Medicine management	Valid details are saved, shown and editable	Missing mandatory fields or invalid dosage schedule are not saved	[ ]
Scheduling and reminders	Reminder fires at the configured time	Invalid time or frequency rejected	[ ]
Dose tracking	Taken or missed status saved against the right medicine and time	Incomplete status update refused	[ ]
History	Earlier records retrieved correctly	Another user's records not accessible	[ ]
Adherence summary and dashboard	Counts match the underlying records	Pending doses not counted as missed	[ ]

The Result column is left open because the project report describes the test design but does not list pass and fail counts. [Authors: complete it from your test log, and add counts, dates and the device and browser used.] After any fix, the affected cases are rerun. Once the system is in use, maintenance covers monitoring, database checks, security updates and user feedback.

VII. DISCUSSION AND LIMITATIONS

MediMate's value lies in joining steps that users now manage separately and in treating a missed dose as something to follow up with support and not as a mark of failure.

The prototype screens show how the workflow is meant to look and feel, and the test design covers both normal use and common errors.

The limitations are clear. First, no user study results are reported, so usability and acceptance are untested here. Second, no study of adherence outcomes has been done, and the literature in Section II does not let us predict an effect for this system.

Third, recorded status depends on honest and timely user input. Fourth, reminder delivery depends on the device. Fifth, OCR and voice recognition can make errors, which is why scanned data needs review and voice actions are confirmed.

Sixth, the test results in Table II still have to be filled in from the project's log, and the implementation status of the scanner, voice interface and caregiver synchronisation should be stated clearly if some exist only as prototype screens.

VIII. CONCLUSION AND FUTURE WORK

We presented MediMate, a Design Thinking–based medicine reminder and adherence tracker that combines scheduling, reminders, dose recording, history, dashboards, a Missed-Dose Care Loop, a reviewed prescription scanner and voice interaction. The work shows a user-centred design process and a prototype. It does not show a clinical benefit.

Future work includes a user study with elderly users and caregivers, analysis of the empathy survey, reliable delivery of notifications across devices, recurring and flexible schedules, medicine refill reminders, stronger authentication and backups, and a measured evaluation of whether the care loop improves recorded adherence.

DECLARATIONS

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DECLARATION OF GENERATIVE AI USE

A generative AI tool (Claude, Anthropic) was used to assist with drafting and language editing of this manuscript. The authors reviewed and verified all content and take full responsibility for it.

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