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IMPROVING MEDICATION ADHERENCE VIA MOBILE APPS: A USER-CENTRIC EVALUATION

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ABSTRACT: Mobile health (mHealth) applications are increasingly used to support adherence by offering reminders, tracking tools and educational features. This narrative review aims to provide a user-centered comparative assessment of commonly available mHealth apps for medication adherence. This study was conducted over a period of 6 months to use and review six mobile apps. Each app was assessed based on eight key parameters such as user interface and navigation, reminder system, medication tracking, adherence support features, data security, customization options, integration and backup capabilities and technical stability. The analysis was based on direct app usage and user experience. My Therapy and Medisafe performed strongly across most parameters offering intuitive interfaces, flexible reminders, robust medication tracking and high data security. Medication Reminder and Alarm & Pill Reminder provided basic functionality with limited advanced features. Pillo, though visually engaging, lacked clinical depth and adherence tracking. Customization and integration features varied widely among the apps. mHealth applications offer valuable support in improving medication adherence. However, their effectiveness is influenced by the depth of features, data protection, and user engagement design. While some apps excel in comprehensive support, others require improvement to meet patient needs and clinical expectations. A structured evaluation of these tools is essential for informed app selection and development.

INTRODUCTION: Mobile health (mHealth) refers to the utilization of mobile device-based technologies to support and enhance public health initiatives. Initially it demonstrated significant potential in delivering accessible health promotion, particularly through short message services (SMS) and phone calls, owing to the widespread penetration, user-friendliness and broad acceptance of mobile phones, especially in low- and middle-income countries ¹.

Advancements in smartphone technologies like Wi-Fi, GPS, Bluetooth, integrated cameras, microphones, accelerometers, sensors and cloud storage have significantly contributed to the widespread adoption of mHealth solutions. Contemporary health applications are now capable of continuously monitoring and collecting a wide range of personal health data such as heart rate, mood fluctuations, physical activity, sleep patterns, dietary behaviors and sexual activity.

These technologies enable the tracking of users health-related behaviors throughout the day, from waking hours to periods of deep sleep thereby facilitating more personalized and data driven health interventions ². The true potential of mobile health applications lies in their capacity to deliver

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personalized and adaptive behavior change interventions in real time. By leveraging user-specific and environmental data these apps can dynamically tailor strategies to individual needs and contexts with the overarching goal of improving health outcomes³.

According to the U.S. Food and Drug Administration (FDA), a mobile medical app is defined as a software application designed to run on a mobile platform and that meets the criteria of a medical device¹. A wide range of mobile applications have been developed to support healthcare professionals with some gaining regulatory approval as 'Software as a Medical Device' (SaMD) because of their functions in diagnosing, treating, curing, mitigating or preventing diseases. However, in 2015, the U.S. Food and Drug Administration (FDA) clarified through official guidance that the majority of health and wellness apps do not meet the criteria for classification as medical devices and thus are not subjected to FDA regulation⁴.

Categories of mHealth Apps: mHealth applications have been classified in several studies according to their intended purpose, target users and functional features. From a developer's point of view apps developed for iOS platforms often emphasize functionalities such as drug and medical information databases, clinical decision support systems, medical reference materials, educational resources, tracking tools, medical calculators and tools aimed at raising health awareness⁵. In low- and middle-income countries (LMICs), mHealth tools have proven beneficial for community health workers by providing access to vital data, enabling disease tracking, supporting treatment compliance and offering diagnostic assistance. These functionalities not only improve the effectiveness of their work but also contribute to better workforce retention⁶. For healthcare professionals, mobile applications support a broad spectrum of clinical and administrative tasks. These include managing information and time, accessing electronic health records, communicating with patients, providing medical references and decision support, facilitating clinical consultations and enabling ongoing medical education¹. Among physicians and medical students, smartphones are widely used for patient monitoring, accessing

general health applications intended for the public, conducting medical research and using student-oriented reference tools to support treatment decisions and disease management⁷. Moreover, the integration of mobile technologies with Geographic Information Systems (GIS) has enhanced various aspects of healthcare delivery by enabling more effective data collection, disease surveillance, health promotion, patient-provider communication and medical education. Therefore, these applications underscore the versatile and far-reaching potential of mHealth technologies across clinical practice, education and public health⁸.

mHealth Apps on Medication Adherence: mHealth applications address a broad spectrum of healthcare needs, from monitoring disease progression to aiding clinical decision-making. Among these, promoting medication adherence has emerged as a critical patient-centered objective. Poor adherence remains a persistent barrier to effective treatment particularly for individuals managing chronic illnesses. To tackle this issue, developers have introduced a range of mobile apps equipped with features like automated medication reminders, adherence tracking and alert notifications all aimed at helping patients stay on track with their prescribed therapies

This review presents an experience-based analysis of these applications, highlighting their features, usability and real-world effectiveness in promoting consistent medication use. The aim of this study is to evaluate the usability, functionality and effectiveness of selected mHealth applications in supporting medication adherence, based on personal experience and real-world use over a seven-month period.

MATERIALS AND METHODS:

Study Design: This review follows a narrative, user-experience-based evaluation design. The primary objective was to explore the usability, functionality and effectiveness of selected mHealth applications aimed at improving medication adherence.

App Selection Criteria:

Inclusion Criteria:

- Availability on Android/iOS platforms.

- Free access (fully or partially usable without subscription).
- Minimum rating of 3.5/5 on Google Play Store or Apple App Store.
- Focus on medication reminder, logging, or adherence tracking features.
- Popularity and user reviews indicating frequent downloads and practical usage.

Exclusion Criteria:

- Apps not primarily focused on medication adherence such as general fitness, diet or symptom tracker apps without a medication reminder function.
- Paid or subscription-only apps that did not offer sufficient functionality in their free version for meaningful evaluation.
- Apps with fewer than 10,000 downloads, suggesting limited real-world use and user engagement.
- Apps that were not available in English or did not support regional availability on the devices used during the evaluation period.
- Apps requiring integration with specific hardware devices (e.g., smart pillboxes or proprietary wearables) for basic functionality.
- Apps that were discontinued, removed from app stores, or technically unstable, with frequent crashes or errors during the review period.

Selected Apps: We have selected six apps based on inclusion criteria: Medication Reminder (Medica) by Spella co. Ltd, My Therapy pill reminder by My Therapy, Alarm and Pill reminder by caiocrol, Take Your Pills- Pill reminder by Take Your Pills, Medisafe Pill & Med Reminder by Medisafe, Pillo- Med Reminder & Tracker by Angry pill alarm.

Evaluation Period: The apps were tested and evaluated for seven months from December 2024 to June 2025. Each app was used for a minimum of 2–4 weeks, ensuring consistent engagement to assess both short-term usability and adherence impact.

Evaluation parameters: Each mobile application was assessed based on multiple key domains to ensure a comprehensive evaluation. These included the user interface (UI) and ease of navigation, focusing on how intuitively users could interact with the app. The reminder system was examined in terms of its customizability and the reliability of notification delivery. Medication logging and tracking features were reviewed to determine how effectively the app allowed users to record, monitor and review their medication intake. Additional adherence support features such as refill reminders, motivational prompts or adherence streaks, were also considered. The assessment included a review of data security and privacy settings, particularly the app's policies on user data protection and access control. Customization options including flexibility in setting dose times, medication names and scheduling were evaluated for their role in enhancing personalization. Furthermore, the apps were analyzed for integration capabilities such as compatibility with wearable devices, electronic health records or cloud backup systems. Lastly, technical stability was assessed by observing app performance during regular use, including responsiveness, loading time and any instances of crashes or bugs.

Data Collection and Analysis: Observations during app usage were systematically documented in a self-maintained logbook throughout the evaluation period. This log captured details such as the specific features utilized within each app, daily experiences with medication reminders and dose logging, and any issues encountered, including missed notifications or technical glitches. Benefits and drawbacks of each application were also noted based on real-time usage and user interaction. To synthesize and compare findings across all evaluated apps, a comprehensive comparative table was developed at the end of the review, highlighting key similarities, differences and overall performance. A qualitative comparative approach was adopted to analyze the subjective user experience with each app. Key strengths, limitations and potential impacts on medication adherence were identified and interpreted in the context of real-world use.

RESULTS: Each selected mobile application was evaluated based on key usability and functionality

parameters, including user interface design, reminder systems, medication tracking capabilities, adherence support features, data privacy, customization, integration compatibility and technical stability.

Medication Reminder App (Medica): The UI is clean and calendar-driven, offering smooth navigation across to-do lists, tasks, and reminder settings. The reminder system is customizable, with options for notification tones and intensity, though it lacks a snooze feature. Medication logging is straightforward, with manual entries and basic tracking. Adherence support features include Excel/PDF export, but there's no streak monitoring or refill alerts. The app supports account login, deletion and privacy settings, though specific encryption protocols are not stated. It allows customization of weekday start, brightness and list order. However, integration with wearables or health records is absent. Technically, the app performs reliably with minimal crashes and fast loading.

MyTherapy Pill Reminder: This app offers a polished, professional UI with intuitive navigation across treatment, activity and progress sections. Its reminder system is highly flexible with interval settings, refill alerts and hidden medication names. Users can log a wide range of data including medication, vitals and doctor appointments. It excels in adherence support, offering travel medication plans, reward points and motivational prompts. Strong privacy controls include encryption and data export. Customization is deep users can select themes, set personal treatment routines and input country specific drug data. While integration with wearables is not built-in, cloud backup and export options are supported. Technical stability is excellent, with fluid responsiveness and no noted crashes.

Alarm & Pill Reminder App: This app combines basic alarm clock tools with medication reminders. The UI resembles a standard alarm interface but includes a calendar and stopwatch for added functionality. The reminder system works well for daily alarms but lacks nuanced scheduling. Medication logging is basic, showing limited customization or tracking history. There are no advanced adherence support tools like refill alerts

or streak logs. It does allow backup and language selection in the profile section, but privacy and data encryption policies are not clearly defined. Customization is modest, with alarm tones and calendar views. Integration features are absent, and technical stability is generally smooth, though occasional lag was noted during tab transitions.

Take Your Pills App: With a clean and minimal interface, this app is beginner-friendly. It supports basic medication reminders and visual pill categorization using shapes and colors. However, it lacks deep customization for dose times or advanced tracking. Adherence tools like refill alerts or reminders to mark doses are not present. While profile creation is available, there's limited information on privacy protection or encryption. The app focuses more on ease than personalization. No integration with health platforms or devices is provided. Performance-wise, it runs smoothly with fast loading times and no crashes during testing.

Medisafe Pill & Med Reminder: Medisafe boasts a sleek, highly intuitive interface with an emotional touch (e.g., Missed Dose Messages). It offers robust reminder customizations with visuals, sounds and detailed scheduling. The app excels at medication tracking with timeline views, "Take" or "Skip" logging and adherence summaries. Adherence support features include refill alerts, caregiver mode and adherence reports. Data security is solid, with account protection and report sharing. Customization is high users can personalize pill appearance, set interaction alerts and opt for premium upgrades. While it lacks wearable integration, it offers cloud backup. Technically, it is stable and fast, with high responsiveness.

Pillo: Angry Pill Reminder: Pillo's standout feature is its gamified, humorous UI with an "Angry Pill" character delivering alerts. Navigation is simple and fun, but limited in depth. Reminders are creative and engaging but not very customizable in medical terms. Logging is basic users mark pills as taken, but there's no historical tracking or dosage adjustment. No adherence analytics or refill alerts exist. Privacy settings are minimal and there's no mention of data protection standards. Customization is limited to basic pill labels and tones. There are no integrations or export options.

It performs well technically and is engaging though not suitable for serious clinical use.

Fig. 1 illustrates a user-centered, domain-wise comparison of six mobile health applications evaluated across eight functional domains: UI and navigation, reminder system, medication tracking, adherence support, data privacy, customization, adherence support, data privacy, customization,

integration capabilities, and technical stability. Each feature was scored using a standardized 3-point ordinal scale (1 = Poor or Absent, 2 = Moderate, 3 = Good or Fully Functional). A comparative evaluation of mHealth apps for medication adherence based on key usability and functional parameters were tabulated in **Table 1**.

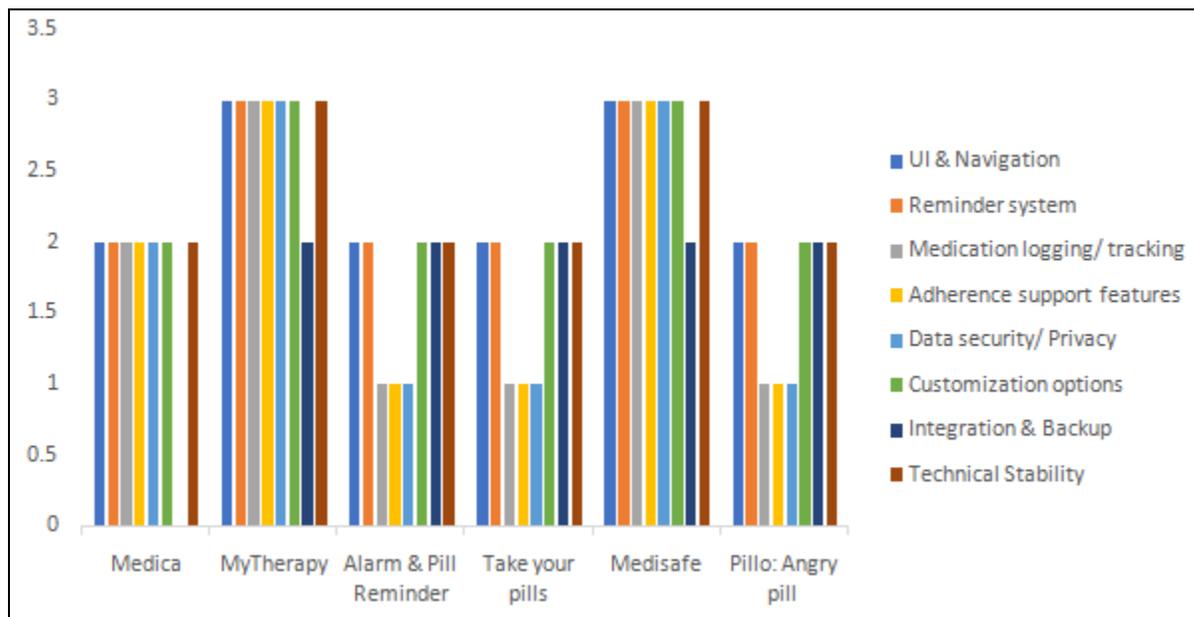


FIG. 1: COMPARATIVE EVALUATION OF mHEALTH APPS FOR MEDICATION ADHERENCE BASED ON KEY USABILITY AND FUNCTIONAL PARAMETERS

TABLE 1: COMPARATIVE EVALUATION OF mHEALTH APPS FOR MEDICATION ADHERENCE BASED ON KEY USABILITY AND FUNCTIONAL PARAMETERS

Criteria	Medica	MyTherapy	Alarm & Pill	Take Your Pills	Medisafe	Pillo: Angry Pill
UI & Navigation	✓□	✓□✓□	✓□	✓□	✓□✓□	✓□
Reminder System	✓□	✓□✓□	✓□	✓□	✓□✓□	✓□
Medication Logging/Tracking	✓□	✓□✓□	✗	✗	✓□✓□	✗
Adherence Support Features	✓□	✓□✓□	✗	✗	✓□✓□	✗
Data Security/Privacy	✓□	✓□✓□	✗	✗	✓□✓□	✗
Customization Options	✓□	✓□✓□	✓□	✓□	✓□✓□	✓□
Integration & Backup	✗	✓□	✓□	✗	✓□	✗
Technical Stability	✓□	✓□✓□	✓□	✓□	✓□✓□	✓□

(✓□- feature is present but basic or limited in scope, ✓□✓□- feature is well developed, □- feature is absent).

DISCUSSION: The evaluation of six medication reminder apps was carried over by systematic user testing and supported by emerging literature demonstrating effectiveness of mHealth tools in improving adherence. A systematic review and meta-analysis reported that mobile medical apps significantly improve medication safety and adherence in chronic disease patients, with positive effects on self-efficacy and reduced medication errors⁹. Another study confirmed that electronic

reminders including smartphone apps reliably increase short-term adherence rates, though long-term effects appear more variable¹⁰.

Consistent with the literature, Medisafe emerged as one of the most effective tools in our evaluation. A randomized controlled trial among medically underserved populations found a 43% increase in adherence rates among users of Medisafe versus under 10% in controls within one month of use.

Studies also highlight that well-designed medication apps improve patient self-efficacy, aligning with our findings of Medisafe's strong adherence support and caregiver modes¹¹. My Therapy combines reminders, tracking and motivational incentives an approach supported by adherence strategies categorized in the literature as most effective when combining behavioral, educational and reminder components. Only about 5 % of apps utilize all three, but such multi-modal features correlate with better clinical outcomes¹². Medica (Spella) and Take Your Pills deliver on foundational reminder functionality. Previous literature suggests that even simple reminder systems can boost adherence by up to 20 % compared to no intervention, particularly in forgetfulness a common barrier to compliance. However, without additional behavioral or educational support, their impact may plateau over time¹³.

Pillo, with its gamified, emotional tone, represents an emerging genre where humor or character-based feedback may help sustain engagement. Literature on gamification approaches shows promise for behavior change, especially in younger demographics, though robust clinical data remains limited (e.g., design-thinking-based studies recommending multi-channel reminders and intake acknowledgment)¹⁴.

Overall, our findings align with broader evidence that apps featuring customizable reminders, tracking tools, motivational or behavioral strategies and caregiver sharing features are more likely to support meaningful adherence gains. Most apps lacked integration with electronic health records or wearables an area future app development should address, as integration may promote seamless adoption in clinical workflows.

CONCLUSION: This review underscores the growing potential of mHealth applications in enhancing medication adherence through digital intervention. Among the evaluated apps, Medisafe and MyTherapy demonstrated the most comprehensive adherence support, intuitive design and secure infrastructure, making them highly suitable for both general and clinical use. Other apps like Medica and Alarm & Pill Reminder offer basic support but may fall short for users needing

advanced tracking and engagement features. While some applications successfully promote adherence through creative or motivational designs, a lack of standardized adherence metrics, clinical validation and integration limits their utility in professional healthcare settings. Future development should focus on combining clinical-grade features with engaging, user-friendly design, ensuring data privacy and enabling integration with electronic health records and wearables.

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CONFLICT OF INTEREST: The authors declare no financial or commercial relationships with the developers or companies of the mobile health applications evaluated in this study. All apps were assessed independently for academic research purposes only.

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