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Mobile Wellness Interventions for Improving Medication-Adherence Behavior

Dr. Maya L. Carter

Assistant Professor, Northbridge School of Public Health, Toronto, Canada

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Abstract

Medication adherence remains a persistent behavioral challenge in the management of chronic disease because the clinical effectiveness of prescribed therapy depends not only on pharmacological efficacy but also on patients' ability and willingness to take medicines consistently over time. Mobile wellness interventions offer a potentially scalable approach to this problem by combining medication reminders with education, self-monitoring, motivational feedback, behavioral prompts, refill support, health coaching, and communication with health professionals. This study examines the contribution of mobile wellness interventions to medication-adherence behavior through a structured integrative synthesis of randomized trials, systematic reviews, meta-analyses, and authoritative digital-health guidance.

The analysis focuses on the behavioral mechanisms through which mobile interventions may influence remembering, motivation, self-efficacy, treatment understanding, routine formation, and patient engagement. Contemporary evidence is broadly favorable but not uniform. A 2025 systematic review of 14 randomized controlled trials found improvement in medication adherence across all included studies, with statistically significant improvement in 10 trials. Meta-analysis demonstrated significant improvement for several adherence outcomes, although results varied according to the measurement instrument and study design. Earlier cardiovascular and hypertension-focused reviews similarly identified beneficial effects while emphasizing substantial heterogeneity in intervention design, duration, app functionality, and adherence measurement.

The present paper proposes that effective mobile wellness interventions should move beyond one-directional reminder systems toward adaptive behavioral support integrating timely cues, comprehensible medication education, progress feedback, patient-centered personalization, self-monitoring, and appropriate clinician connectivity. Particular attention is also required for usability, digital literacy, accessibility, privacy, alert fatigue, sustained engagement, and unequal access to smartphones or connectivity. The findings indicate that mobile wellness technologies can strengthen medication-taking behavior when embedded within a broader model of patient-centered care; however, they should complement rather than replace clinical assessment, shared decision-making, and professional medication management. Future research should prioritize longer follow-up, standardized adherence measures, objective medication-taking indicators, implementation studies, and intervention designs capable of identifying which digital components produce sustained behavioral change.

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1. Introduction

Medication use is one of the most common therapeutic strategies for preventing disease progression, controlling chronic conditions, reducing complications, and improving quality of life. The effectiveness of medication, however, depends on whether patients initiate therapy, follow the prescribed dosing schedule, and persist with treatment for the required duration. Medication nonadherence is therefore not merely a failure to remember tablets; it is a complex behavioral phenomenon influenced by treatment beliefs, adverse effects, regimen complexity, affordability, health literacy, psychological factors, and communication with clinicians, daily routines, social support, and access to care. The World Health Organization has long emphasized that adherence is multidimensional rather than exclusively patient dependent. More recent digital-health policy likewise recognizes that appropriately designed digital technologies can support health-system delivery and individual self-management when issues of equity, implementation, safety, and usability are addressed.

The widespread use of smartphones has created new opportunities to intervene at the exact moments when medication-taking behavior occurs. Conventional adherence support commonly depends on periodic consultations, written instructions, pill organizers, telephone follow-up, or counseling. Mobile interventions extend these strategies into daily life through scheduled notifications, interactive medication lists, dose logging, refill alerts, symptom tracking, educational material, automated feedback, motivational messages, and communication functions. Lanke and colleagues reported that contemporary adherence applications include reminder functions, medication information, adherence logs, refill support, and data-sharing capabilities, while some systems employ more interactive approaches such as conversational agents or tailored educational content. This ability to deliver repeated, context-sensitive support distinguishes mobile wellness interventions from one-time educational encounters.

Evidence supporting these approaches has expanded considerably, although the magnitude and consistency of benefit remain variable. Lanke and colleagues' 2025 systematic review examined 14 randomized controlled trials involving chronic conditions and found that all reported improvement in medication adherence, with statistically significant improvement in 10 trials. Their pooled analyses showed significant improvement on the eight-item Morisky Medication Adherence Scale and percentage-based adherence outcomes, although not every adherence instrument produced a statistically significant between-group difference. Similarly, Al-Arkee and colleagues reviewed mobile applications for cardiovascular disease and identified statistically significant adherence improvements in nine randomized trials, while noting pronounced heterogeneity in intervention characteristics and effect estimates. These findings suggest that mobile technology can support adherence but also show that effectiveness cannot be assumed merely because an intervention is delivered through a smartphone.

A critical issue is therefore the distinction between a mobile reminder and a broader mobile wellness intervention. A reminder primarily addresses prospective memory: it informs a patient that a medication is due. A wellness-oriented intervention can address a wider behavioral system by strengthening treatment knowledge, perceived necessity, self-efficacy, routine formation, goal setting, feedback, communication, and self-management. Some patients may primarily require timely cues,

whereas others may miss medication because of concerns about adverse effects, misunderstanding of treatment benefits, competing responsibilities, financial barriers, or low confidence in managing a complex regimen. Evidence from cardiovascular applications has similarly indicated that combinations of reminders, education, and professional involvement are common, while the exact contribution of individual components remains uncertain.

2. Objectives of the Study

2.1 To Evaluate the Behavioral Influence of Mobile Wellness Interventions

The first objective is to examine whether smartphone applications, text-based systems, behavioral notifications, educational tools, digital adherence trackers, and related mobile interventions can positively influence medication-taking behavior. The analysis distinguishes improvement in adherence behavior from improvement in downstream clinical outcomes because a change in self-reported medication use does not necessarily produce an immediate change in blood pressure, glycemic control, hospitalization, or other clinical endpoints.

2.2 To Identify the Active Components Supporting Adherence

The second objective is to identify intervention characteristics most plausibly associated with sustained behavioral benefit. These include medication reminders, personalized schedules, education, self-monitoring, visual progress feedback, refill notifications, behavioral reinforcement, motivational communication, clinician involvement, social support, and adaptive messaging. The objective is not to assume that every feature is necessary but to identify how different components respond to different causes of nonadherence.

2.3 To Develop a Patient-Centered Mobile Wellness Framework

The third objective is to develop an implementation-oriented framework in which mobile adherence support complements routine health care. Particular consideration is given to usability, digital literacy, personalization, privacy, data security, accessibility, clinical integration, notification burden, and sustained user engagement.

3. Review of Literature

3.1 Development of Mobile Medication-Adherence Support

Early digital adherence interventions frequently relied on short-message-service reminders or relatively simple medication alarms. These interventions were attractive because they could deliver low-cost prompts repeatedly without requiring a health professional to contact every patient manually. Subsequent smartphone applications expanded the model by introducing interactive medication lists, calendars, tracking tools, educational resources, symptom monitoring, refill management, and communication functions.

Thakkar and colleagues' meta-analysis of mobile telephone text messaging demonstrated that mobile communication could improve medication adherence across chronic diseases, establishing an important early evidence base for scalable digital adherence support. Later application-based reviews broadened this evidence. Armitage, Kassavou, and Sutton evaluated randomized trials of mobile

applications designed specifically to support medication adherence and reported evidence favoring app-based approaches while also identifying methodological variation between studies.

Peng and colleagues similarly concluded that mobile applications could improve medication adherence among adults with chronic diseases, although they cautioned that evidence quality and intervention duration limited the certainty of conclusions. The significance of these findings lies not simply in demonstrating that smartphones can issue reminders but in establishing medication adherence as a behavior that can be influenced through repeated digital contact.

3.2 Evidence Across Chronic Disease Populations

Research has increasingly examined mobile adherence interventions within specific chronic diseases. Hypertension has received particular attention because medication is frequently required over long periods, the disease can remain asymptomatic, and inadequate adherence can compromise blood-pressure control.

Márquez Contreras and colleagues evaluated a hypertension-specific smartphone intervention in a cluster-randomized design, while Abu-El-Noor and colleagues conducted a randomized clinical trial in which the mobile intervention included medication reminders, follow-up reminders, and educational information. The latter study reported greater improvement in treatment-adherence measures within the intervention group after three months.

The MedISAFE-BP randomized clinical trial provides a particularly important caution against overinterpreting behavioral outcomes. Morawski and colleagues found a modest improvement in self-reported adherence among application users, but the intervention did not produce a corresponding significant improvement in systolic blood pressure. The result illustrates why adherence scores and clinical outcomes should be assessed separately.

Mikulski and colleagues' systematic review and meta-analysis of mobile applications for hypertension found evidence supporting improved medication adherence, although heterogeneity across applications and studies remained important. Xu and colleagues likewise concluded that smartphone app-based interventions among people with hypertension were associated with increased medication adherence as well as reductions in blood pressure, while calling for further investigation of behavioral coaching and related features.

3.3 From Reminder Technology to Behavioral Wellness

A recurrent limitation in the literature is the inability to isolate which application components are responsible for successful adherence outcomes. Al-Arkee and colleagues identified substantial variation in application functionality: some interventions were primarily educational, some relied on reminders, and others combined reminders and education. Health professionals participated in several of the reviewed interventions, making it difficult to determine whether benefit resulted from technology, clinician contact, or their combination.

This methodological problem is important because medication nonadherence has multiple causes. An alert may be effective when forgetfulness is the primary barrier but may be ineffective when patients intentionally avoid treatment because of adverse effects, concerns about dependence, perceived

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lack of necessity, cost, or uncertainty about instructions. Mobile wellness interventions therefore require behavioral matching: the support provided should correspond to the reason that adherence is difficult.

Lanke and colleagues' 2025 review strengthens this interpretation. Twelve of the fourteen applications evaluated contained explicit medication-reminder functions, but several also incorporated more sophisticated elements such as symptom monitoring, medication information, interactive engagement, adherence logging, and disease-specific support. The authors concluded that mobile applications can improve adherence while emphasizing the need to determine which application features generate the greatest benefit.

4. Research Methodology

4.1 Research Design

This study employed a structured integrative evidence-synthesis and secondary analytical approach. It was designed to evaluate mobile wellness interventions without presenting invented patient-level data. Evidence was drawn from randomized controlled trials, systematic reviews, meta-analyses, peer-reviewed digital-health literature, and World Health Organization digital-health guidance available up to May 10, 2020.

The literature search focused on combinations of the terms mobile health, mHealth, mobile wellness, medication adherence, medication compliance, smartphone application, digital intervention, medication reminder, chronic disease, hypertension, cardiovascular disease, and behavior change. Priority was given to research containing quantitative adherence outcomes, randomized comparisons, systematic evidence synthesis, or clearly described mobile intervention features.

4.2 Evidence Eligibility and Analytical Variables

Evidence was prioritized when it evaluated adult patients receiving continuing pharmacotherapy and contained a mobile component intended to improve adherence. Studies involving reminders, smartphone applications, text messages, education, self-monitoring, behavioral coaching, electronic adherence records, or clinician-connected mobile systems were considered relevant.

Table 1: Analytical Framework for Mobile Wellness and Medication Adherence

Domain	Variables Considered	Analytical Purpose
Behavioral barrier	Forgetfulness, motivation, treatment beliefs, routine disruption	Identify reason for nonadherence
Reminder functionality	Dose alerts, scheduling, refill notifications	Support prospective memory
Educational support	Medication information, disease education	Improve knowledge and perceived necessity
Self-monitoring	Dose logging, adherence history, symptom tracking	Increase behavioral awareness
Feedback	Progress visualization, reinforcement, personalized messaging	Strengthen motivation

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Clinical connectivity	Data sharing, professional follow-up, consultation	Support continuity of care
Personalization	Timing, language, regimen adaptation, tailored messages	Improve intervention relevance
User experience	Simplicity, accessibility, digital literacy	Improve sustained engagement
Primary outcome	Medication-adherence behavior	Evaluate direct behavioral effect
Secondary outcome	BP, disease control, health utilization, quality of life	Evaluate potential clinical impact

4.3 Evidence Synthesis and Outcome Interpretation

The study did not pool new patient-level data. Instead, quantitative findings from existing reviews and randomized trials were compared according to study design, population, intervention characteristics, adherence measure, and statistical direction.

Medication adherence was treated as a behavioral outcome that may be measured through self-report instruments, pill counts, electronic monitoring, pharmacy records, or percentage-based adherence measures. Lanke and colleagues noted substantial variation in adherence measurement across trials and reported that most included studies used self-reported instruments, which introduces possible recall and social-desirability bias.

Because no original human participants were recruited and no identifiable patient information was collected for the present manuscript, institutional ethics approval was not applicable to this evidence-synthesis design. Any future empirical validation of the proposed framework involving patients should obtain appropriate ethics approval and informed consent.

5. Analysis

5.1 Comparative Evidence of Intervention Effectiveness

The contemporary evidence base provides moderate support for mobile interventions but also demonstrates meaningful variation in effectiveness.

Table 2: Comparative Evidence on Mobile Interventions and Medication Adherence

Study	Evidence Design	Population / Scope	Main Adherence Finding	Interpretation
Lanke et al., 2025	Systematic review and meta-analysis	14 RCTs; chronic conditions	10 of 14 RCTs reported statistically significant adherence improvement	Strong contemporary evidence, but heterogeneous methods
Al-Arkee et al.,	Systematic review and	16 RCTs; cardiovascular	9 RCTs reported significant	Favorable effect with

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2021	meta-analysis	disease	adherence improvement	high heterogeneity
Mikulski et al., 2022	Systematic review and meta-analysis	Hypertension	Evidence favored improved adherence	Results varied among applications
Morawski et al., 2018	Randomized clinical trial	Uncontrolled hypertension	Small improvement in self-reported adherence; no significant SBP improvement	Behavioral benefit did not automatically translate to clinical outcome
Abu-El-Noor et al., 2021	Randomized clinical trial	Hypertension	Greater treatment-adherence improvement with mobile application	Combined reminders and education were beneficial

5.2 Evidence Profile of Randomized Trials

Figure 1: Evidence Profile of Mobile-App Effects on Medication Adherence

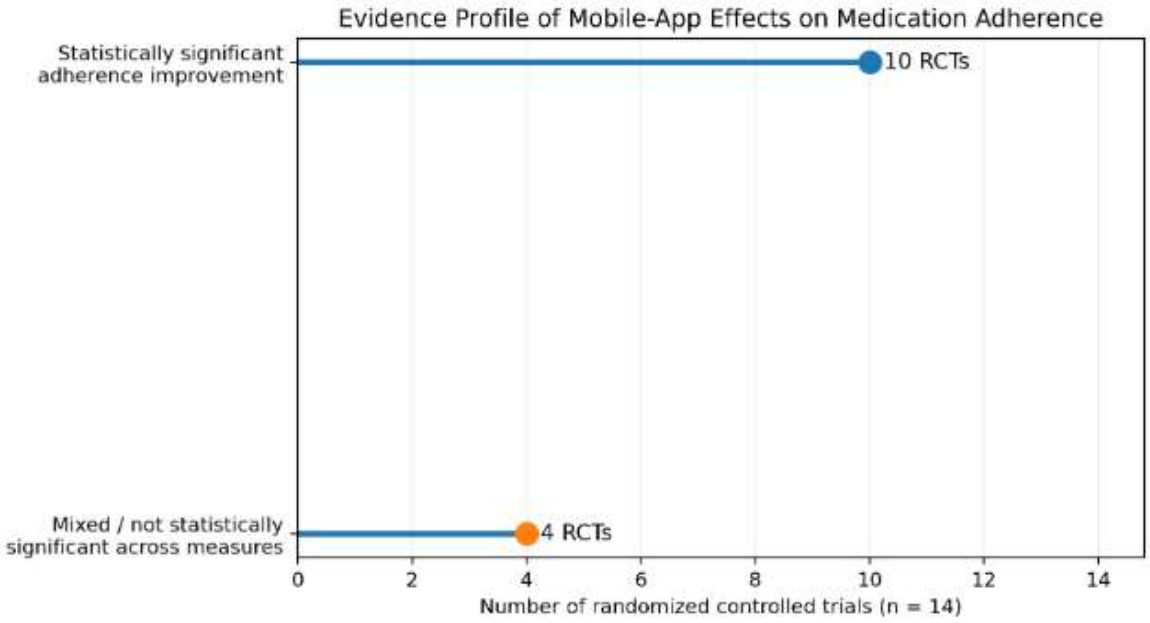

Figure interpretation: The pattern supports a positive overall signal for mobile adherence interventions but does not justify the claim that every application is effective. Intervention content, adherence measures, sample characteristics, follow-up duration, and comparator conditions differ substantially across studies.

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5.3 Behavioral Mechanism of Mobile Wellness Intervention

The evidence suggests that adherence improvement can be conceptualized as a sequence of connected behavioral processes:

Medication Schedule Recognition
↓
Timely Mobile Cue
↓
Patient Attention and Recall
↓
Medication Knowledge and Perceived Necessity
↓
Dose-Taking Decision
↓
Digital Confirmation or Self-Monitoring
↓
Personalized Feedback and Reinforcement
↓
Repeated Routine Formation
↓
Improved Medication-Adherence Behavior

This pathway explains why repeated engagement can potentially be more effective than isolated reminders. A digital intervention can act before a missed dose through anticipatory prompting, during the medication-taking decision through education and motivation, and after the behavior through logging and feedback.

The framework also clarifies why mobile systems may fail. If nonadherence results from intolerable adverse effects, inability to obtain medication, incorrect prescribing, treatment complexity, or deliberate treatment refusal, additional reminders may increase notification burden without resolving the underlying problem. Such cases require clinical, pharmaceutical, financial, or shared decision-making interventions rather than additional digital prompting.

6. Discussion

6.1 Mobile Wellness as a Behavioral Support System

The findings support a transition from viewing adherence applications as electronic alarm clocks toward understanding them as behavioral support environments. Medication taking is repetitive and occurs primarily outside clinical settings. Mobile interventions are therefore uniquely positioned to operate within the patient's everyday routine.

The strongest contemporary evidence indicates that mobile applications can improve adherence across several chronic conditions. Lanke and colleagues reported significant pooled improvements for multiple adherence outcomes, while Al-Arkee and colleagues similarly observed a favorable overall effect among cardiovascular populations.

Nevertheless, intervention effectiveness depends on more than technical functionality. A system that repeatedly generates alerts without considering a person's daily schedule, medication concerns, literacy, treatment complexity, or preferences may be ignored. Effective design therefore requires personalization and low-friction interaction.

Mobile wellness systems should ideally support several behavioral tasks simultaneously: remembering the dose, understanding why medication is required, recognizing progress, managing refills, maintaining confidence, communicating concerns, and identifying situations requiring professional assistance.

6.2 Why Multicomponent Interventions May Be More Sustainable

Reminder-only interventions primarily target unintentional nonadherence. Their effectiveness may decline when repeated notifications become familiar and are dismissed automatically. Multicomponent interventions have the potential to address a wider range of behavioral barriers by combining reminders with education, monitoring, reinforcement, coaching, and clinician communication.

Evidence from cardiovascular applications demonstrates that successful interventions often contain several functions rather than a single technological component. Al-Arkee and colleagues reported applications using education, reminders, or both, with health professionals involved in a substantial proportion of trials. At the same time, the authors emphasized that the diversity of these components prevented confident identification of the specific features responsible for improvement.

This represents an important direction for future research. Instead of continuing to ask only whether an application improves adherence, trials should compare intervention components directly. For example, factorial studies could determine whether reminders alone perform differently from reminders plus education, personalized feedback, clinician messaging, or behavioral coaching.

Sustained effectiveness must also be evaluated beyond short follow-up periods. Lanke and colleagues found intervention durations ranging from 30 days to 12 months and concluded that available evidence is insufficient to establish the optimal duration or frequency of application use.

6.3 Clinical Integration, Equity, and Research Limitations

Mobile wellness interventions should not be interpreted as substitutes for medication counseling, clinical monitoring, or shared decision-making. Morawski and colleagues' MedISAFE-BP trial illustrates this distinction: adherence behavior improved modestly, but systolic blood pressure did not significantly improve relative to control. A clinically meaningful intervention must therefore evaluate both behavioral adherence and appropriate disease-specific outcomes.

Equity requires comparable attention. Smartphone-based systems may disadvantage individuals with limited digital literacy, visual or cognitive impairment, unreliable connectivity, limited device access, language barriers, or concerns about privacy. WHO's digital-health strategy emphasizes that digital transformation should support equitable access and strengthen health systems rather than create additional exclusion.

Data protection is especially relevant because adherence applications may store medication names, diagnoses, dosing schedules, behavioral histories, and health measurements. Systems intended

for clinical deployment require clear consent procedures, appropriate security, transparent data-use policies, and safeguards against unnecessary collection or commercial use of sensitive health data.

7. Conclusion

Mobile wellness interventions represent a promising approach for improving medication-adherence behavior, particularly when they move beyond simple reminders and provide integrated behavioral support. Current randomized and meta-analytic evidence generally indicates favorable adherence effects, although intervention efficacy varies considerably according to population, application functionality, duration, adherence measurement, and study quality.

The principal value of mobile wellness technology lies in its ability to deliver support during everyday medication-taking situations. Timely reminders can address forgetfulness; education can strengthen treatment understanding; self-monitoring can increase behavioral awareness; personalized feedback can reinforce progress; and communication functions can connect patients with professional support when difficulties arise.

The evidence nevertheless does not support treating all medication applications as equally effective or assuming that improved self-reported adherence will automatically generate better clinical outcomes. Mobile technologies should therefore be incorporated within patient-centered medication management rather than deployed as replacements for clinical care. Future development should prioritize adaptive personalization, accessibility, privacy, sustained engagement, objective adherence measurement, clinician integration, and rigorous long-term evaluation. A well-designed mobile wellness intervention is consequently best understood not as a digital alarm, but as a continuous behavioral support system capable of strengthening the routines, knowledge, confidence, and care relationships required for sustained medication adherence.

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