

Digital Therapies for Substance Use Disorders: Recent Advances and Engagement Strategies

Tyler S Oesterle , Nicholas L Bormann 

Department of Psychiatry and Psychology, Mayo Clinic, Rochester, MN, USA

Correspondence: Tyler S Oesterle, Department of Psychiatry and Psychology, Mayo Clinic, 200 First Street SW, Rochester, MN, 55905, USA, Email oesterle.tyler@mayo.edu

Background: Substance use disorders (SUDs) are highly prevalent, chronic conditions that often go untreated. Technology-driven interventions, including digital therapeutics, web-based programs, and mobile applications, have expanded treatment access. The COVID-19 pandemic accelerated the adoption of digital approaches, and national policy calls for enhanced use of telehealth and app-based recovery support. However, user engagement with SUD apps remains a challenge.

Objective: This narrative review summarizes evidence on digital interventions for SUDs, emphasizing mobile apps. It examines what differentiates effective interventions, drawing on insights from the broader context of general mobile app use. It also proposes strategies to enhance engagement in digital therapeutics.

Methods: We reviewed the literature (2013–2025) on SUD digital interventions, including randomized trials, systematic reviews, and large observational studies of SUD-focused apps. Key findings on clinical efficacy and engagement were extracted, along with examining engagement tactics from mobile gaming and other app domains to inform potential improvements.

Results: Several apps have demonstrated efficacy in reducing substance use or supporting abstinence, particularly those that integrate evidence-based therapy content, provide personalized feedback, offer craving-management tools, and facilitate connectivity to peer or clinician support. In contrast, apps with minimal interactive content often show no added benefit. A major barrier is sustaining user engagement, as many SUD apps experience a steep drop-off in use after the initial download. Strategies such as gamification, contingency management (utilizing incentives), social networking features, and integration with ongoing care can significantly enhance engagement. Early data suggest that blending these strategies into SUD apps yields higher retention and better clinical results.

Conclusion: Mobile apps are emerging as valuable adjuncts for SUD treatment, but their real-world impact depends on users' engagement with compelling content. By incorporating tangible rewards, personalized and timely interventions, social support, and provider involvement, digital therapies for SUDs enhance engagement and, consequently, improve long-term recovery outcomes.

Keywords: substance use disorder, digital therapeutics, mobile health, mHealth, smartphone application, user engagement, relapse prevention

Introduction

Substance use disorders (SUDs) are a significant public health challenge, with high prevalence and low treatment uptake. In the United States, an estimated 17% of adults met SUD criteria in 2023, yet only about 15% received SUD treatment.¹ Globally, this treatment gap is similarly concerning. Barriers such as limited treatment availability, overall cost, time constraints, and stigma have been shown to limit individuals from engaging in traditional in-person care.¹ Digital therapeutics offer a means to overcome traditional treatment barriers and expand access to SUD treatment.¹ These technology-driven interventions deliver therapeutic content via devices and platforms people use daily. For SUD treatment, digital therapeutics include web-based cognitive-behavioral therapy (CBT) programs, telehealth counseling, automated text message support, and smartphone applications (apps).^{2,3}

App-based interventions are promising given the ubiquity of mobile devices. In 2024, approximately 97% of US adults reported owning a mobile phone, with 85–90% having a smartphone.⁴ Over 80% of individuals in addiction treatment programs have a smartphone, and a majority reported interest in using app-based tools as a part of their

recovery plan.⁵ Health apps thus offer the potential for on-demand, scalable SUD care unconstrained by clinic hours or location. The COVID-19 pandemic accelerated interest in digital modalities for SUD treatment. Pandemic-related lockdowns and social distancing forced many outpatient programs, counseling services, and mutual-help meetings (eg, 12-step groups) to curtail in-person contact. In response, providers and patients rapidly turned to telehealth and mobile apps to maintain care continuity.^{2,6} During this period, regulatory changes in some countries expanded tele-SUD services (for instance, allowing buprenorphine initiation via telemedicine), and awareness of digital recovery tools grew. The United States Office of National Drug Control Policy noted the potential for telehealth and apps to expand access to SUD treatment, helping to move digital therapeutics from the periphery and closer to the mainstream.⁷ Overall, there is insufficient evidence to support the general efficacy of apps in reducing substance use; however, specific apps that incorporate evidence-based strategies show the most promise. For example, one study, using meta-regression, showed that CBT and contingency management (CM)-based apps demonstrated statistically significant effects compared to control interventions.²

A potential weakness of app-based treatments, which may contribute to their modest efficacy, is poor user engagement. It is estimated that approximately 77% of users stop using an app within 3 days of installation. Fewer than 10% remain active after 30 days.⁸ Even in controlled trials, where participants are typically more motivated and often compensated, adherence to digital interventions tends to decline after the first few weeks. One study of digital interventions for SUD and mental health reported a median of only 5.5 days of actual use across multi-week study periods.⁵ These issues are compounded by the intersectionality of mental illness and SUD—individuals with co-occurring disorders engage less with treatment and have worse outcomes than those with mental illness alone.⁹

Similar engagement issues are encountered in SUD-specific apps. In a real-world implementation trial of an alcohol-intervention app in outpatient clinics, about half of those who initially engaged stopped using the app by 3 months.¹⁰ Reported reasons included lack of time, forgetting, and losing interest. Many participants described the app as helpful but failed to integrate it into their daily routine. Premature discontinuation may have prevented an otherwise effective intervention from demonstrating its benefit.¹⁰

These engagement barriers highlight the importance of understanding not only what digital interventions include but also how they are designed, delivered, and sustained in real-world use. To integrate emerging evidence across these areas, this narrative review builds on prior meta-analytic work from our group and others to examine app-based interventions for SUD treatment.^{2,3} A narrative approach is well suited to this goal, as it allows for integrating new empirical findings, conceptual advances, and implementation experiences beyond the scope of systematic reviews.

We begin by comparing app features associated with demonstrated benefits to identify the essential components of effective digital interventions beyond therapeutic content. We then examine user engagement, drawing on evidence from addiction medicine, behavioral science, and adjacent fields such as mental health and mobile gaming. Next, we highlight strategies that may be used to enhance engagement, retain app users, and ultimately improve treatment outcomes in SUD-focused apps. Finally, we consider gaps in knowledge and future directions, including design considerations and research priorities to advance the field of digital SUD therapeutics. The goal of this review is to inform clinicians, researchers, and policymakers about the current capabilities and limitations of app-based digital therapeutics for SUD treatment and to identify actionable opportunities to strengthen their effectiveness, scalability, and long-term impact.

Methods

We reviewed the National Library of Medicine PubMed database utilizing the Medical Subject Headings (MeSH) terms and keyword searches. Examples of key term searches utilized included: addiction or abuse; substance or abuse; alcohol or addiction; opioid or addiction; alcohol or stimulant addiction or cannabis; addiction or stimulant abuse or detoxication; drug metabolic or substance withdrawal and application; computer software and application; mobile. The focus was to review articles published in the last 10 years, in English. We excluded studies that did not focus on mobile phone applications as a treatment option for patients with SUDs. Ultimately, this led to 14 studies deemed appropriate for inclusion.^{2,11–23} We then evaluated these review articles for overlapping studies that identified therapeutic treatment strategies with the highest potential for efficacy.

Overlapping and recurring engagement strategies were synthesized and organized into four themes (user experience, gamification, personalization, and social connectivity) and described across phases of app use (onboarding, ongoing engagement, sustained engagement). As a pragmatic behavioral lens to help interpret why certain features may influence engagement, we considered how strategies align with common determinants of behavior described in the Theoretical Domains Framework (TDF) (eg, reinforcement, social influences, environmental context/resources).²⁴

Current Landscape of SUD Digital Therapeutics: Efficacy and Features

Digital interventions promoting recovery from SUDs include stand-alone, direct-to-consumer apps, along with interventions integrated into formal treatment or aftercare. Randomized controlled trials (RCTs) and systematic reviews have shown that some apps demonstrate clear benefits, while others show minimal or adverse effects.^{2,3,25} Emerging evidence indicates that certain features are associated with positive outcomes and others are linked to adverse outcomes.² In this section, we review specific examples of app-based intervention strategies that have been featured in recent reviews^{2,3,25} to highlight what appeared to be the most beneficial therapeutic strategies to date.

Evidence from Select Trials

A-CHESS (Addiction-Comprehensive Health Enhancement Support System), a recovery support app for people with alcohol use disorder, was one of the first apps to attempt a large RCT to test the app's efficacy over 1 year. Adults ($n=349$) discharged from residential treatment were randomized to 12 months of A-CHESS in addition to treatment as usual (TAU), versus only TAU.²⁶ A-CHESS delivered multiple components, including weekly check-in surveys with semi-tailored feedback, on-demand CBT-based coping tools, a "panic button" to alert someone in the participant's support network, GPS-triggered alerts when near high-risk locations (eg, bars previously frequented), and a peer discussion forum. Participants receiving A-CHESS had significantly fewer risky drinking days and a higher likelihood of sustained abstinence over 12 months compared to controls.²⁶ Rates of continuous abstinence were approximately 52% in the A-CHESS group vs 40% in controls at 12 months.²⁶ Greater engagement was associated with superior outcomes, with participants who used the app at least weekly having more favorable drinking outcomes.¹⁰

In a smaller study looking at the same population, the LBMI-A (Location-Based Monitoring and Intervention for Alcohol) app was evaluated in a pilot RCT. The app provided personalized support through real-time coping suggestions when participants reported high craving, psychoeducation modules, and GPS-based alerts when nearing high-risk locations.²⁷ In a six-week trial ($n=28$), those assigned to LBMI-A achieved greater reductions in drinks per drinking day and a higher proportion of abstinent days than a control group that received only a pamphlet and web links.²⁷ While preliminary, this indicated that real-time, tailored interventions via an app could acutely reduce drinking.

Evidence from smoking cessation trials also provides valuable insights for SUD digital therapeutics. In a large RCT ($n=684$), the multi-component smoking cessation app QuitAdvisor+ contained individualized information about quitting options, daily motivational messaging, a quitting diary, and an individualized quitting benefits tracker. It achieved a 1-month self-reported quit rate of 28.5% vs 16.9% in a control group using a simpler "information only" app.²⁸ Similarly, an RCT of the SmokeFree app found that participants assigned to the full-featured version (eg, daily "missions", progress tracking, community support) had higher short-term abstinence rates than the minimal information-only version.²⁹ These findings suggest that interactive, theory-driven features such as structured quit plans, tailored messages, and reward systems are more effective than static or purely informational content.

In opioid use disorder, the FDA-cleared app reSET-O (based on an earlier version called reSET)³⁰ has shown benefit when used as an adjunct to buprenorphine treatment. The app delivers a 12-week interactive CBT program with CM, prescribed in conjunction with outpatient pharmacotherapy. Participants who received TAU plus the app were more likely to abstain from opioids in weeks 9–12 (the primary endpoint) than those receiving TAU alone (77.3% vs 62.1%, $p=0.02$, OR=2.08, 95% CI: 1.10–3.95). Furthermore, participants in the app group also had a lower risk of leaving treatment (HR=0.49, 95% CI: 0.26–0.92).³¹

By contrast, several digital interventions without active therapeutic content have failed to demonstrate benefit. In a Swedish RCT among young adults ($n=1932$), the alcohol self-monitoring app Promillekoll, which allows users to log drinks and view estimated blood alcohol concentration (BAC) without guiding to reduce consumption, was investigated.

App users actually increased their drinking frequency, contrary to the researchers' hypothesis. The authors concluded that simply providing BAC feedback and informational tools without behavioral intervention components may not be adequate.³² Similarly, in a 6-month trial, the smoking cessation app Stop-Tabac, which delivered generic tips and news but no evidence-based therapeutic content, produced no improvement in quit rates compared with TAU (abstinence ~10% in both groups).³³ A pilot RCT of Coach2Quit, which paired a personal carbon monoxide breath sensor with an app to track smoking behavior, also did not significantly increase tobacco cessation rates over TAU.³⁴ Again, the authors speculated that the lack of behavioral feedback or therapeutic guidance based on carbon monoxide monitoring may have contributed to these negative results.

Findings from these trials suggest that several features are standard to effective SUD apps and often absent from ineffective ones (see Table 1). Apps that deliver or reinforce established treatment strategies (CBT, motivational enhancement, relapse prevention planning, CM) tend to yield better outcomes. Personalization keeps users engaged (eg, content feels more relevant), enhancing efficacy by targeting an individual's unique triggers. Moreover, when apps were used as adjuncts to formal treatment and clinicians monitored and/or encouraged their use, results were generally more positive^{26,29} than when apps were used completely independently. Effective apps frequently include progress tracking (eg, days abstinent, money saved, health improvements), which provides positive reinforcement and self-awareness. Apps providing participant feedback and provider alerts on use trajectories (eg, improvements or concerning patterns) were associated with maintaining behavior change. In contrast, simple tracking without feedback (eg, Promillekoll, Coach2Quit) did not result in improved outcomes.^{32,34}

Strategies to Improve Engagement with SUD Apps

Engagement with SUD-focused apps is a major challenge and is directly linked to treatment outcomes.² Successful mobile games, such as Candy Crush, and social media platforms, like Facebook, attract millions of users who return daily, often multiple times per day, over extended periods. This high level of engagement relies on established incentive structures to maximize engagement.³⁵ Although their goals differ from those of health-focused interventions, many of the same principles can be ethically applied to improve engagement with digital therapeutics for SUD treatment.^{36–39}

Several recent review articles have focused on identifying ideal engagement strategies for mental health-related mobile phone applications.^{36–39} These articles offer complementary perspectives on engagement strategies that have proven to be

Table 1 Features with Evidence-Based Positive Clinical Outcomes

Feature	Effective Apps	Ineffective Apps	Examples
Evidence-based therapeutic strategies	Deliver or reinforce established treatment strategies (CBT, motivational enhancement, relapse prevention planning, contingency management)	Often absent	reSET-O, A-CHESS, LBMI-A, QuitAdvisor+
Personalization and interactive adaptation	Tailor content to users' context and progress; personalized messages; adjust difficulty as the user progresses	One-size-fits-all, static content fails to engage diverse users	A-CHESS (location/risk alerts), QuitAdvisor+ (personalized messages), SmokeFree (adjusted daily missions)
On-Demand support for cravings and triggers	24/7 coach, real-time support during high-risk moments	Retrospective monitoring only (eg, end-of-day logging)	A-CHESS (panic button), LBMI-A (instant coping suggestions), mindfulness app (urge-surfing exercises)
Social connectivity or clinician involvement	Peer and/or clinician support, discussion forums, counselor messaging, adjunct to in-person treatment	Lacks social elements, used independently, easier to abandon	A-CHESS (discussion forum), smoking cessation apps (social sharing, counselor messaging)
Outcome monitoring with feedback	Progress tracking (days abstinent, money saved, health improvements), participant feedback, provider alerts	Simple tracking without feedback	A-CHESS (location/risk alerts), QuitAdvisor+ (personalized messages), SmokeFree (adjusted daily missions)

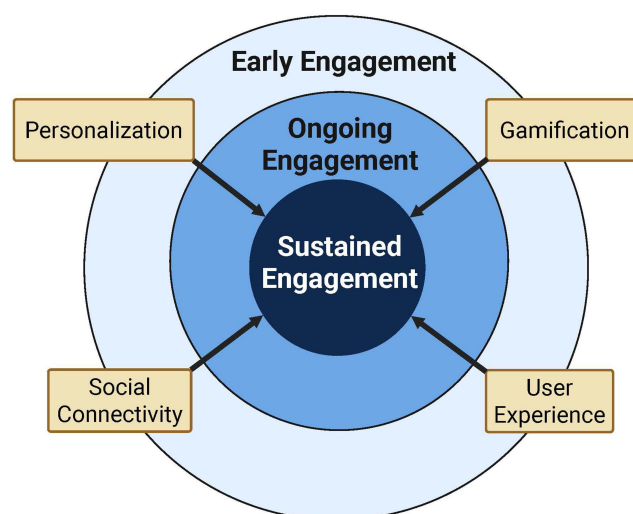


Figure 1 Conceptual Framework for Digital Engagement in Substance Use Disorder Treatment.

Notes: Framework illustrating early, ongoing, and sustained engagement phases in digital substance use disorder treatment. Core components of personalization, gamification, social connectivity, and user experience interact to enhance motivation, adherence, and recovery outcomes.

more or less effective. These articles identify four critical elements—user experience, gamification, personalization, and socialization—as central to fostering app engagement among patients with SUDs (see Figure 1). User experience encompasses aspects of apps that facilitate integration into a participant’s life, make the app aesthetically pleasing, and provide confidence in the approach the app is taking. Gamification encompasses aspects that engage a participant’s competitive instincts and desire to recognition within a competitive cohort, as well as elements that make using the app feel more game-like. Personalization encompasses aspects of apps that are tailored to a particular participant or are aware of the individual’s context for use. Finally, socialization within the app includes aspects that facilitate human interaction with other patients or health professionals. Each plays a distinct role depending on the duration of app use (see Table 2).

Early Engagement (0–30 Days)

User Experience

Many factors can influence an individual’s perception of high-quality versus low-quality user experience. However, a well-designed app onboarding process is crucial for fostering a positive initial engagement with patients of all ages and

Table 2 Engagement Strategy Effectiveness by Recovery Stage

Engagement Stage	Common Drop-Off Causes	Recommended Strategies	Rationale
Early Engagement (0–30 days)	Confusion, lack of perceived value	Onboarding & Setup, Integration with Treatment, Privacy & Trust, Gamification (CM, daily streaks, frequent rewards), and Social Connectivity (clinician check-ins),	Builds routine and reinforces initial motivation
Ongoing Engagement (1–6 months)	Boredom, repetitive content	Personalization, Push Notifications, Gamification (escalating challenges, tangible rewards), Social Connectivity (peer support), Content Updates	Maintains interest and addresses emerging relapse risks
Sustained Engagement (>6 months)	Loss of motivation, no accountability	Progress tracking, Social Connectivity (peer support, community leadership roles), Gamification (escalating challenges, adaptive goals), Content Updates	Encourages sustained use and deeper engagement

Notes: Summarizes real-world reasons individuals stop engaging with substance use disorder treatment–related mobile applications. The Theoretical Domains Framework was used to link engagement strategies to likely behavioral drivers that may change over time. Timeframes are relative guideposts rather than fixed stages, and individuals may move through them faster or slower depending on clinical needs and treatment setting.

social demographics.^{36–39} An ideal onboarding process should guide users through key features, keeping the initial setup brief and minimizing practical barriers to engagement. In-app tutorials or live professionals should orient users as they explore the app. Thoughtful onboarding reduces friction, supports early follow-through, limits initial drop-out, and helps establish positive expectations for continued use.⁴⁰

The onboarding process should include information on privacy and confidentiality from the outset.⁴¹ Clear, accessible privacy options help build trust, increase the likelihood of honest use of the app and help patients remain anonymous, especially in social settings. The app must also provide participants with control over data sharing (eg, allowing them to choose whether to enable location tracking) and provide clear, transparent explanations of how patients' data are collected and used.³⁷

Gamification

Gamification can be very helpful in fostering initial engagement. Early rewards and reinforcement encourage users to return.⁴² Apps that provide quick reinforcement, such as check-ins or progress bars, help participants build momentum to establish regular use.⁴² Daily incentives and streak tracking also support routine engagement.⁴¹ However, it is essential to strike a balance between challenges. If early challenges are too easy, boredom can occur, and if they are too hard, they can lead to frustration.^{43,44} Studies show that competitive approaches against other (perhaps more experienced) users are perceived as more difficult than collaborative experiences where one works with other users toward a common goal.⁴⁵ Beginning with simple tasks and progressing to more complex ones is often a safe approach to build confidence and a sense of progression without frustration.

Personalization

Tailoring app content to each user's goals and circumstances increases relevance and supports both early and sustained engagement.³⁶ For example, during enrollment, users could identify their primary objectives, such as maintaining sobriety, gradually reducing consumption, or improving their mental health. The app's dashboard could then prioritize features that align with these goals and intentions. Contextual interventions could further enhance engagement by delivering prompts at high-risk times or locations, such as evenings, weekends, or areas associated with prior substance use.^{26,44} Even simple personalization, such as greeting users by name, referencing past achievements, or offering supportive messages after a lapse in engagement, can make the app feel more responsive, empathetic, and non-judgmental.⁴⁶

Social Connectivity

For SUD treatment groups, using peer recovery coaches or licensed counselors adds accountability and empathy that digital tools lack. Similarly, early adoption of mobile phone applications for SUD is significantly enhanced by engagement and interaction with professionals.³⁶ Integrating human support into SUD apps can boost engagement and effectiveness by strengthening accountability and social support. Providers can monitor app data and discuss progress during sessions for users already in treatment, reinforcing accountability.⁴⁷ For those outside of formal care, in-app coaching services, such as text messaging or video calls with peer recovery coaches or counselors, can encourage and provide personalized guidance.^{48,49} The addition of human contact can help extend an app from a self-help educational tool to an impactful component of care.⁴⁷ Designating a supportive friend or family member to receive updates or alerts when concerning patterns arise and further strengthen accountability and sustain engagement.

Ongoing Engagement (1–6 Months)

User Experience

Push notifications are helpful user experience design features that promote ongoing engagement. Notifications as a design feature need to be timely, relevant, and user-controlled. Starting with daily prompts can help cue attention and build habits. These can be transitioned to event-based alerts after a period of inactivity or upon the delivery of new content. Messages should be short, friendly, and actionable, like "Tip of the day: When cravings surge, try a two-minute walk. Open the app for a guided exercise". Regular updates to notification content can maintain its relevance, and providing notifications with substantive information rather than purely promotional messages may support ongoing user

engagement.^{50,51} However, overuse of notifications can cause fatigue and lead users to mute alerts altogether, removing their benefit.^{50,52}

Gamification

Incorporating gamified features can also help sustain engagement by recognizing users' consistency and progress and providing ongoing reinforcement.⁵³ For example, apps may award points or virtual "coins" for completing daily check-ins, activities, or sobriety milestones. These points or "coins" could unlock new app content and features or be exchanged for tangible rewards, such as coupons or gift cards, that mimic clinic-based CM strategies.⁴⁹ Multi-day challenges and unique digital rewards (like badges) also boost engagement through achievement.⁵⁴ Progressive challenges, where users unlock new skills, modules, or feedback as they advance, help sustain curiosity and promote persistence.⁵⁵ The best design invites persistence without overwhelming the user.⁴³ For example, features that encourage users to stay engaged by letting them reset streaks or recover points after a lapse support participation rather than discouraging it.⁵⁶

Personalization

Personalized push notifications also play a crucial role in ongoing engagement and can help prevent fatigue from overuse. Evidence suggests that tailoring message timing and tone enhances adherence to app-based interventions.²⁸ However, qualitative studies indicate that reminders are most effective when users are already motivated and when delivery feels supportive rather than intrusive, reinforcing perceived usefulness.⁵⁰ Context-specific prompts may further enhance engagement. For example, the HeartSteps app, which delivers activity reminders based on location and time, increased step counts by 24% immediately after delivery versus no prompt. However, effects diminished with the growing use of notifications, suggesting users became habituated.⁵¹

Social Connectivity

Social features provide another avenue for sustained use. Many consumer apps maintain engagement by leveraging social dynamics. Because addiction recovery often involves addressing social disconnection, features that facilitate peer interaction, whether through mutual support groups or in-app communities, may be particularly valuable.

Building opportunities for peer interaction within an app can counter isolation and foster accountability through social influence. Features such as moderated forums, group challenges, or anonymous message boards allow users to share experiences and receive support. Scheduled events, such as live group chats or Q&A sessions with content experts, can create reasons to return regularly. Clear community guidelines and active moderation are needed to ensure these spaces remain safe and recovery-oriented.⁴¹ Furthermore, community leaderboards related to the app's gamification can tap into users' competitive instincts and create a sense of flow, while collaborative tasks foster shared purpose and connection.⁴⁵

Sustained Engagement (>6 Months)

User Experience

Sustaining user interest requires that apps evolve over time. Adding new educational materials, guided exercises, or seasonal resources can provide users with a reason to stay engaged long term. Incorporating brief announcements (eg, "New today: a guided meditation for stress") can re-engage lapsed users and help prevent the experience from becoming stagnant.

Sustained engagement strategies focused on user experience should evolve based on user data and feedback. Analytics can identify drop-off points, prompting targeted interventions at those times. Underused features can be refined or removed to streamline the experience. Communicating improvements back to users (for example, "New version: craving forecast added based on your feedback") reinforces that their input matters and strengthens investment in the app.⁵⁷

Personalization

Over time, an adaptive system should personalize messaging by observing engagement patterns and adjusting the frequency or content accordingly. Apps are more likely to persist when they align with existing routines rather than feel like an added burden.⁵⁸ Some apps synchronize with calendars to schedule brief check-ins at natural times, such as

morning planning or evening reflection.³⁷ Integration with wearable devices can provide discreet prompts based on sensor data, such as a smartwatch vibration, prompting a craving intervention.²⁵ Embedding activities into daily habits, such as the daily commute, lunch break, or bedtime, can help engrain the intervention as a consistent aspect of one's recovery and support self-regulation over time.³⁷

Gamification

Games often use fresh content or limited-time events to keep users engaged, and health apps can adopt similar strategies.⁴² Weekly challenges, rotating educational materials, or minor visual updates can make the experience feel current and relevant. Rotating challenges or updating notifications and prompts signal that the app remains active.

Social Connectivity

Over time, engaged participants may take on roles as community “champions”, welcoming newcomers and modeling positive behavior, which further strengthens commitment and a sense of belonging to the app community. Qualitative studies have shown that SUD app users who participated in peer discussions reported greater accountability to their online peers and higher overall activity.¹⁰ A systematic review of 263 studies found that social gaming enhanced relatedness and social presence, suggesting that collaborative features can strengthen community ties and sustain participation.⁵⁹ Survey data from the COVID-19 pandemic further support these benefits, as social gaming helped individuals maintain contact during a period of widespread isolation.⁶⁰

Future Directions

Mobile apps and other digital tools have emerged as potential supports in SUD treatment and recovery. The increasing comfort with telehealth has aligned with the expanding interest in digital therapeutics overall, yet to realize their full potential, these tools must overcome both efficacy and engagement hurdles.³

A central challenge is the lack of long-term efficacy data. Most existing trials follow participants for only three to six months, leaving unanswered whether digital tools provide benefits one or two years later. It remains unclear whether time-limited use is sufficient or whether periodic re-engagement, like booster sessions in chronic disease management, is needed to sustain gains. Given the continuing risk of relapse, health systems may need to provide ongoing access to recovery apps.

Real-world implementation research is equally important. Evidence from controlled settings does not always translate into practice. Barriers such as clinic workflow, staff familiarity, and technical support can limit use.⁶¹ Dissemination strategies, such as integrating apps into discharge planning, employee assistance programs, or outpatient follow-up, may promote adoption; however, the best approach to implementing this is unknown and requires further study. As digital therapeutics become more established, healthcare payers may begin to reimburse them or include them in benefit plans, thereby encouraging providers to adopt them. Indeed, one prescription digital therapeutic for SUD (reSET) has FDA approval and some insurance coverage, suggesting a pathway for others.³⁰ However, FDA review applies to only a subset of products that meet criteria as Software as a Medical Device (SaMD). Many SUD-related apps fall outside that pathway, so clinical claims, supporting evidence, and privacy practices vary widely and are not consistently subject to FDA premarket review.

Rapid technological progress is likely to expand the capabilities of digital tools in recovery care. The reasons for continued or resumed substance use are multifactorial and complex to isolate, but new analytic methods may help identify patterns that preceded relapse. Artificial intelligence and biosensor technologies can analyze multiple individualized factors to more effectively stratify risk and guide interventions.²⁵ For example, machine learning could detect changes in user engagement or mood reports and prompt supportive feedback, such as, “It looks like you’ve been isolating more and feeling down. These changes sometimes occur before returning to use. Here are some suggestions”. Biosensors could transmit relevant physiological data directly to apps, reducing user burden and allowing earlier detection of concerning trends. Prototype devices already exist, including wearable alcohol sensors and smart pill dispensers that monitor medication adherence.²⁵ Integrating such tools with recovery apps could enhance accountability and provide real-time data; however, these advances raise essential privacy and autonomy considerations.⁴⁴ Transparent

communication and user choice, facilitated through an opt-in design, will be crucial. More research is clearly needed to tailor content delivery for specific patient contexts and presentations. For example, an individual ambivalent about change may benefit from motivational enhancement and harm reduction, whereas someone recently discharged from treatment might require relapse-prevention support. Adolescents may prefer a more gamified or peer-network-focused platform, while older adults may prioritize simplicity and clarity. Digital therapeutics can also be combined with medications and counseling as part of an integrated care plan. For example, a patient with opioid use disorder might receive buprenorphine, therapy, and a recovery app simultaneously, each addressing different aspects of treatment.³¹

Clinicians ultimately want effective interventions. For medications, benefit depends on adherence. For digital therapeutics, benefit depends on engagement, making this a critical area of study. Four major engagement themes have emerged from the literature (see Figure 1). Given the complex and sometimes treatment-refractory nature of addiction,⁶² practical approaches will likely require combining multiple tactics rather than relying on a single method. By implementing these strategies, SUD digital interventions can become more engaging and better integrated into daily life. Enhanced engagement leads to more consistent receipt of therapeutic content. This is technically and clinically important, as greater engagement with evidence-based content has been correlated with better clinical outcomes.²

In a new paradigm where digital tools play a significant role in SUD treatment, addressing the digital divide becomes crucial. While many people have smartphones, not everyone has equal access to or comfort with technology, which risks digital therapeutics inadvertently exacerbating existing disparities. Coaching solutions, such as partnerships with libraries or community centers to provide digital access and coaching, may help extend reach to underserved populations. Future efforts could include training and support for people who are less familiar with apps, and in some cases, alternate formats such as text messaging or phone-based support may work better. Long-term sustainability may depend on how digital therapeutics are financed and built into insurance benefits. Coverage could speed adoption by lowering out-of-pocket costs, but it could also widen disparities if reimbursement primarily supports commercial payers. Keeping apps affordable is important, since expensive devices or recurring app access fees could exclude many potential users. Finally, tailoring content through language, cultural values, or spiritual framing can also improve inclusivity and impact.³⁰

This article has several limitations. First, we focused our search on PubMed and the included articles' bibliographies, which may have led us to miss relevant work indexed elsewhere. Second, digital therapeutics encompass a wide range of software-delivered interventions. This review centers on engagement, drawing primarily from the app-based SUD literature while also incorporating supporting evidence from adjacent contexts where engagement has been studied more extensively. The time-based engagement phases used to organize strategies were intended to serve as practical guideposts rather than fixed stages; some individuals may move through them faster or slower depending on clinical needs and treatment setting. We emphasize smartphone-delivered tools because they are common in real-world rollout and align with how many patients access digital support. This focus may have limited attention to other modalities. Third, because engagement is defined and measured inconsistently across studies, we chose a narrative approach. A systematic review could improve completeness and transparency, but it would still be limited by inconsistent definitions, and reporting is engagement across studies. Finally, because the app marketplace changes quickly, durable engagement principles were the focus rather than drawing conclusions about specific products or platforms.

Conclusion

Digital therapeutics for SUD treatment have advanced rapidly over the past decade. Mobile apps extend care beyond clinics by offering ongoing recovery support wherever it is needed. Because apps are relatively inexpensive, easy to update, and widely accessible, they have real potential to narrow the treatment gap and reach people who might otherwise not receive support. The goal is to strengthen human care by empowering anyone seeking recovery to access evidence-based digital tools that work in harmony with compassionate professionals and supportive peers. Early research has been encouraging; however, the current app's evidence base leaves several practical questions unanswered. Many studies do not follow patients long enough to know the enduring effects of apps. Engagement is inconsistently assessed, limiting comparisons across apps and making it difficult to define a meaningful "dose" (amount and duration of use). SUDs are also heterogeneous, including meaningful differences within a single substance (eg, stimulant use via

inhalation, insufflation, or injection), and future studies should better account for this clinical variation when designing and evaluating interventions. Gamification and related strategies must always be implemented with care. The intent should be to educate and reinforce positive behaviors such as coping, and help-seeking, not to trivialize addiction or create unhealthy dependence.⁶³ When applied thoughtfully, these methods can make recovery more interactive, rewarding, and sustainable.³⁷ Finally, there remains limited evidence on policy and economic impact, including whether apps reduce downstream utilization. Wide-spread implementation and utilization will depend partly on how these tools are financed and incorporated into routine care, and whether reimbursement decisions expand access or unintentionally widen disparities. Future studies should prioritize longer-term outcomes, standardized engagement measurement, and app designs that reflect clinical differences across SUDs. Closing these gaps will help clarify where apps add the most value in SUD treatment.

Disclosure

Dr Tyler Oesterle reports grants from AHRQ, during the conduct of the study; non-financial support from Koa Health and Franelle, outside the submitted work. In addition, Dr Tyler Oesterle has a patent licensed to Koa Health. The authors report no other conflicts of interest in this work.

References

1. Liu L, Zhang C, Nahata MC. Trends in treatment need and receipt for substance use disorders in the US. *JAMA Network Open*. 2025;8(1): e2453317–e2453317. doi:10.1001/jamanetworkopen.2024.53317
2. Oesterle TS, Hall-Flavin DK, Bormann NL, et al. Therapeutic content of mobile phone applications for substance use disorders: an umbrella review. *Mayo Clin Proceed*. 2024;2(2):192–206. doi:10.1016/j.mcpdig.2024.03.004
3. Torous J, Bucci S, Bell IH, et al. The growing field of digital psychiatry: current evidence and the future of apps, social media, chatbots, and virtual reality. *World Psychiatry*. 2021;20(3):318–335. doi:10.1002/wps.20883
4. Gelles-Watnick R. Americans' use of mobile technology and home broadband. *Pew Res Center*. 2024.
5. Hsu M, Martin B, Ahmed S, Torous J, Suzuki J. Smartphone ownership, smartphone utilization, and interest in using mental health apps to address substance use disorders: literature review and cross-sectional survey study across two sites. *JMIR Form Res*. 2022;6(7):e38684. doi:10.2196/38684
6. Oesterle TS, Kolla B, Risma CJ, et al. Substance use disorders and telehealth in the COVID-19 pandemic era: a new outlook. *Mayo Clin Proc*. 2020;95(12):2709–2718. doi:10.1016/j.mayocp.2020.10.011
7. Office of National Drug Control Policy. National drug control strategy. Executive Office President; 2022.
8. Flyer A. 2025 app retention benchmarks report. Available from: <https://www.appsflyer.com/resources/reports/app-retention-benchmarks/>. Accessed February 10, 2025.
9. Herbeck DM, Fitek DJ, Sviki DS, Montoya ID, Marcus SC, West JC. Treatment compliance in patients with comorbid psychiatric and substance use disorders. *Am J Addict*. 2005;14(3):195–207. doi:10.1080/1055049050949488
10. Glass JE, McKay JR, Gustafson DH, et al. Treatment seeking as a mechanism of change in a randomized controlled trial of a mobile health intervention to support recovery from alcohol use disorders. *J Subst Abuse Treat*. 2017;77:57–66. doi:10.1016/j.jsat.2017.03.011
11. Bahadoor R, Alexandre JM, Fournet L, Gellé T, Serre F, Auriacombe M. Inventory and analysis of controlled trials of mobile phone applications targeting substance use disorders: a systematic review. *Front Psychiatry*. 2021;12:622394. doi:10.3389/fpsy.2021.622394
12. Holmes NA, van Agteren JE, Dorstyn DS. A systematic review of technology-assisted interventions for co-morbid depression and substance use. *J Telemed Telecare*. 2019;25(3):131–141. doi:10.1177/1357633x17748991
13. Suffoletto B, Scaglione S. Using digital interventions to support individuals with alcohol use disorder and advanced liver disease: a bridge over troubled waters. *Alcohol Clin Exp Res*. 2018;42(7):1160–1165. doi:10.1111/acer.13771
14. Tofighi B, Abrantes A, Stein MD. The role of technology-based interventions for substance use disorders in primary care: a review of the literature. *Med Clin North Am*. 2018;102(4):715–731. doi:10.1016/j.mcna.2018.02.011
15. Nesvåg S, McKay JR. Feasibility and effects of digital interventions to support people in recovery from substance use disorders: systematic review. *J Med Internet Res*. 2018;20(8):e255. doi:10.2196/jmir.9873
16. Colbert S, Thornton L, Richmond R. Smartphone apps for managing alcohol consumption: a literature review. *Addict Sci Clin Pract*. 2020;15(1):17. doi:10.1186/s13722-020-00190-x
17. Nuamah J, Mehta R, Sasangohar F. Technologies for opioid use disorder management: mobile app search and scoping review. *JMIR Mhealth Uhealth*. 2020;8(6):e15752. doi:10.2196/15752
18. Staiger PK, O'Donnell R, Liknaitzky P, Bush R, Milward J. Mobile apps to reduce tobacco, alcohol, and illicit drug use: systematic review of the first decade. *J Med Internet Res*. 2020;22(11):e17156. doi:10.2196/17156
19. Kazemi DM, Li S, Levine MJ, Auten B, Granson M. Systematic review of smartphone apps as a mhealth intervention to address substance abuse in adolescents and adults. *J Addict Nurs*. 2021;32(3):180–187. doi:10.1097/jan.0000000000000416
20. Satre DD, Meacham MC, Asarnow LD, Fisher WS, Fortuna LR, Iturralde E. Opportunities to integrate mobile app-based interventions into mental health and substance use disorder treatment services in the wake of COVID-19. *Am J Health Promot*. 2021;35(8):1178–1183. doi:10.1177/08901171211055314
21. Manning V, Whelan D, Piercy H. The current evidence for substance use disorder apps. *Curr Opin Psychiatry*. 2022;35(4):237–245. doi:10.1097/ycp.0000000000000800

22. Villanueva-Blasco VJ, Eslava D, Olave L, Torrens M. Electronic interventions in primary care to address substance use: a systematic review. *Addict Behav.* **2024**;156:108073. doi:10.1016/j.addbeh.2024.108073
23. Scialanca M, Alexander K, Tofighi B. Digital psychosocial interventions tailored for people in opioid use disorder treatment: scoping review. *J Med Internet Res.* **2025**;27:e69538. doi:10.2196/69538
24. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implement Sci.* **2012**;7(1):37. doi:10.1186/1748-5908-7-37
25. Oesterle TS, Karpyak VM, Coombes BJ, et al. Systematic review: wearable remote monitoring to detect nonalcohol/nonnicotine-related substance use disorder symptoms. *Am J Addict.* **2022**;31(6):535–545. doi:10.1111/ajad.13341
26. Gustafson DH, McTavish FM, Chih MY, et al. A smartphone application to support recovery from alcoholism: a randomized clinical trial. *JAMA Psychiatry.* **2014**;71(5):566–572. doi:10.1001/jamapsychiatry.2013.4642
27. Gonzalez VM, Dulin PL. Comparison of a smartphone app for alcohol use disorders with an internet-based intervention plus bibliotherapy: a pilot study. *J Consult Clin Psychol.* **2015**;83(2):335–345. doi:10.1037/a0038620
28. BinDhim NF, McGeechan K, Trevena L. Smartphone smoking cessation application (SSC App) trial: a multicountry double-blind automated randomised controlled trial of a smoking cessation decision-aid 'app'. *BMJ Open.* **2018**;8(1):e017105. doi:10.1136/bmjopen-2017-017105
29. Crane D, Ubhi HK, Brown J, West R. Relative effectiveness of a full versus reduced version of the 'Smoke Free' mobile application for smoking cessation: an exploratory randomised controlled trial. *F1000Res.* **2018**;7:1524. doi:10.12688/f1000research.16148.2
30. Campbell AN, Nunes EV, Matthews AG, et al. Internet-delivered treatment for substance abuse: a multisite randomized controlled trial. *Am J Psychiatry.* **2014**;171(6):683–690. doi:10.1176/appi.ajp.2014.13081055
31. Maricich YA, Bickel WK, Marsch LA, Gatchalian K, Bothyl J, Luderer HF. Safety and efficacy of a prescription digital therapeutic as an adjunct to buprenorphine for treatment of opioid use disorder. *Curr Med Res Opin.* **2021**;37(2):167–173. doi:10.1080/03007995.2020.1846022
32. Gajecki M, Berman AH, Sinadinovic K, Rosendahl I, Andersson C. Mobile phone brief intervention applications for risky alcohol use among university students: a randomized controlled study. *Addict Sci Clin Pract.* **2014**;9(1):11. doi:10.1186/1940-0640-9-11
33. Etter JF, Khazaal Y. The Stop-tabac smartphone application for smoking cessation: a randomized controlled trial. *Addiction.* **2022**;117(5):1406–1415. doi:10.1111/add.15738
34. Krishnan N, Elf JL, Chon S, Golub JE. COach2Quit: a pilot randomized controlled trial of a personal carbon monoxide monitor for smoking cessation. *Nicotine Tob Res.* **2019**;21(11):1573–1577. doi:10.1093/ntr/nty182
35. Ryan T, Chester A, Reece J, Xenos S. The uses and abuses of Facebook: a review of Facebook addiction. *J Behav Addict.* **2014**;3(3):133–148. doi:10.1556/jba.3.2014.016
36. Lipschitz JM, Pike CK, Hogan TP, Murphy SA, Burdick KE. The engagement problem: a review of engagement with digital mental health interventions and recommendations for a path forward. *Curr Treat Options Psychiatry.* **2023**;10(3):119–135. doi:10.1007/s40501-023-00297-3
37. Boucher EM, Raiker JS. Engagement and retention in digital mental health interventions: a narrative review. *BMC Digital Health.* **2024**;2(1):52. doi:10.1186/s44247-024-00105-9
38. Elkes J, Cro S, Batchelor R, et al. User engagement in clinical trials of digital mental health interventions: a systematic review. *BMC Med Res Method.* **2024**;24(1):184. doi:10.1186/s12874-024-02308-0
39. Smith KA, Ward T, Lambe S, et al. Engagement and attrition in digital mental health: current challenges and potential solutions. *NPJ Digit Med.* **2025**;8(1):398. doi:10.1038/s41746-025-01778-w
40. Pratap A, Neto EC, Snyder P, et al. Indicators of retention in remote digital health studies: a cross-study evaluation of 100,000 participants. *Npj Digital Med.* **2020**;3(1):21. doi:10.1038/s41746-020-0224-8
41. Szinay D, Jones A, Chadborn T, Brown J, Naughton F. Influences on the uptake of and engagement with health and well-being smartphone apps: systematic review. *J Med Internet Res.* **2020**;22(5):e17572. doi:10.2196/17572
42. Lewis ZH, Swartz MC, Lyons EJ. What's the Point?: a review of reward systems implemented in gamification interventions. *Games Health J.* **2016**;5(2):93–99. doi:10.1089/g4h.2015.0078
43. Csikszentmihalyi M, Csikszentmihalyi M. *Flow: The Psychology of Optimal Experience*. Harper & Row New York; 1990.
44. Businelle MS, Perski O, Hébert ET, Kendzor DE. Mobile health interventions for substance use disorders. *Annu Rev Clin Psychol.* **2024**;20(1):49–76. doi:10.1146/annurev-clinpsy-080822-042337
45. Pereira F, Bermúdez IBS, Jorge C, Cameirão MS. The use of game modes to promote engagement and social involvement in multi-user serious games: a within-person randomized trial with stroke survivors. *J Neuroeng Rehabil.* **2021**;18(1):62. doi:10.1186/s12984-021-00853-z
46. Cottrell-Daniels C, Jones DM, Bell SA, Bandlamudi M, Spears CA. Mindfulness and mobile health for quitting smoking: a qualitative study among predominantly African American adults with low socioeconomic status. *Am J Qualitative Res.* **2021**;6(1):19. doi:10.29333/ajqr/11427
47. Werntz A, Amado S, Jasman M, Ervin A, Rhodes JE. Providing human support for the use of digital mental health interventions: systematic meta-review. *J Med Internet Res.* **2023**;25:e42864. doi:10.2196/42864
48. Fortuna KL, Naslund JA, LaCroix JM, et al. Digital peer support mental health interventions for people with a lived experience of a serious mental illness: systematic review. *JMIR Ment Health.* **2020**;7(4):e16460. doi:10.2196/16460
49. Oesterle TS, Bormann NL, Paul MM, et al. Treatment of substance use disorders with a mobile phone app within rural collaborative care management (Senyo health): protocol for a mixed methods randomized controlled trial. *JMIR Res Protoc.* **2025**;14:e65693. doi:10.2196/65693
50. Dennison L, Morrison L, Conway G, Yardley L. Opportunities and challenges for smartphone applications in supporting health behavior change: qualitative study. *J Med Internet Res.* **2013**;15(4):e2583. doi:10.2196/jmir.2583
51. Klasnja P, Smith S, Seewald NJ, et al. Efficacy of contextually tailored suggestions for physical activity: a micro-randomized optimization trial of HeartSteps. *Ann Behav Med.* **2019**;53(6):573–582. doi:10.1093/abm/kay067
52. McGreevey III JD, Mallozzi CP, Perkins RM, Shelov E, Schreiber R. Reducing alert burden in electronic health records: state of the art recommendations from four health systems. *Appl Clin Inform.* **2020**;11(01):001–012. doi:10.1055/s-0039-3402715
53. Prendergast M, Podus D, Finney J, Greenwell L, Roll J. Contingency management for treatment of substance use disorders: a meta-analysis. *Addiction.* **2006**;101(11):1546–1560. doi:10.1111/j.1360-0443.2006.01581.x
54. Park S, Kim S. A badge design framework for a gamified learning environment: cases analysis and literature review for badge design. *JMIR Serious Games.* **2019**;7(2):e14342. doi:10.2196/14342

55. Taylor S, Ferguson C, Peng F, Schoeneich M, Picard RW. Use of in-game rewards to motivate daily self-report compliance: randomized controlled trial. *J Med Internet Res*. 2019;21(1):e11683. doi:10.2196/11683
56. Clark L, Zack M. Engineered highs: reward variability and frequency as potential prerequisites of behavioural addiction. *Addict Behav*. 2023;140:107626. doi:10.1016/j.addbeh.2023.107626
57. Fu B, Lin J, Li L, Faloutsos C, Hong J, Sadeh N. Why people hate your app: making sense of user feedback in a mobile app store. presented at: Proceedings of the 19th ACM SIGKDD international conference on Knowledge discovery and data mining; 2013; Chicago, Illinois, USA. doi:10.1145/2487575.2488202.
58. Vaghefi I, Tulu B. The continued use of mobile health apps: insights from a longitudinal study. *JMIR Mhealth Uhealth*. 2019;7(8):e12983. doi:10.2196/12983
59. Gonçalves D, Pais P, Gerling K, Guerreiro T, Rodrigues A. Social gaming: a systematic review. *Comput Hum Behav*. 2023;147(C):31. doi:10.1016/j.chb.2023.107851
60. Ballard ME, Spencer MT. Importance of social videogaming for connection with others during the COVID-19 pandemic. *Games Cult*. 2023;18(2):251–264. doi:10.1177/15554120221090982
61. Hadani Y, Tarikogullari I, Oesterle TS, et al. Care coordination in screening, brief intervention, and referral to treatment (SBIRT): a scoping review. *Am J Addict*. 2026;35(1):22–35. doi:10.1111/ajad.70104
62. Bormann NL, Burson JR, Burson EM, et al. How treatment-refractory addiction is defined: a scoping review. *J Addict Med*. 2024:10–97.
63. Moldon L, Strohmaier M, Wachs J. How gamification affects software developers: cautionary evidence from a natural experiment on GitHub. In: 2021 IEEE/ACM 43rd International Conference on Software Engineering (ICSE). 2021:549–561.

Substance Abuse and Rehabilitation

Publish your work in this journal

Substance Abuse and Rehabilitation is an international, peer-reviewed, open access journal publishing original research, case reports, editorials, reviews and commentaries on all areas of addiction and substance abuse and options for treatment and rehabilitation. The manuscript management system is completely online and includes a very quick and fair peer-review system. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <http://www.dovepress.com/substance-abuse-and-rehabilitation-journal>

Dovepress
Taylor & Francis Group