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The Role of Technology-Based Interventions for Substance Use Disorders in Primary Care: A Review of the Literature

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INTRODUCTION

The burden of alcohol and substance use disorders (SUDs) is significant. For example, costs associated with opioid use disorder in 2013 were estimated at $78.5 billion and opioid-related overdose deaths have increased by 200% in the last 15 years.[1] Excessive alcohol use remains a leading modifiable cause of death and cost an estimated $250 billion in 2010.[2,3] However, nearly 50 years after the introduction of pharmacotherapies for SUDs, fewer than 10% of individuals with SUD are linked to treatment.[4]

Primary care settings are optimally positioned to reduce the burden of SUDs by providing a patient-centered care model for addiction treatment and related comorbidities (prescribing pharmacotherapies, patient education, and access to specialty care).[5,6] Costs of expanding addiction treatment to office-based settings are offset by reductions in emergency department visits and hospitalizations, and improved addiction and medical outcomes.[6,7] However, effective management of SUDs is seldom delivered in primary care. Patient-level barriers to office-based management of SUDs include cost, insurance limitations, stigma, and transportation.[8,9] Among physicians trained in SUD care, lack of adequate administrative and clinical support impede the delivery of effective medication-assisted therapies and psychosocial interventions targeting SUDs.[10,11]

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The integration of innovative technology-based interventions (eg, computer-based and Web-based interventions, text messaging, interactive voice recognition, smart-phone apps, and emerging technologies) in primary care has the potential to address gaps in care for individuals with SUDs (Table 1).[12–14] This pairing of effective technology-based interventions (TBIs) with primary care has already shown improvements in appointment adherence, diabetes self-management, smoking cessation, and human immunodeficiency virus (HIV) care.[15–17] Importantly, TBIs readily enhance between-visit patient engagement with their care by easing patient-physician communication, point of service data gathering, and adherence management, and offering the delivery of evidence-based psychosocial interventions with high fidelity.[12,13,16,18]

Advances in emerging technologies have also accelerated the development and delivery of effective TBIs targeting SUDs in specialty addiction treatment settings.[12,13,18,19] Patient surveys in primary care signal high acceptability and uptake of TBIs to enhance the management of SUDs.[20,21] Although primary care often constitutes the mainstay of medical care for populations with SUDs,[22] efforts to expand TBIs in primary care for the treatment of SUDs have yet to be fully realized. Adoption of evidence-based interventions targeting SUDs in primary care may produce positive outcomes comparable with those observed in specialty addiction treatment settings.[14,19,23,24]

This article describes the rapidly evolving nature of TBIs targeting alcohol and illicit substance use in community and outpatient addiction treatment settings and implications for integrating TBIs in primary care to reduce the burden of SUDs. It primarily focuses on computer-based and Web-based interventions, text messaging, interactive voice recognition, and smartphone applications supported by randomized controlled trials and evidence-based behavior change models (eg, cognitive behavior therapy [CBT], community reinforcement approach [CRA], therapeutic education system).[18]

Computer and Web-Based Interventions

Recent reviews and meta-analyses suggest that computer-based and Web-based interventions are a cost-effective approach to expand the reach of evidence-based psychotherapeutic interventions, reduce the burden of SUDs in community and specialty addiction treatment settings, and show clinical outcomes (improved cognitive functioning, retention of behavior change techniques, treatment engagement, and abstinence) comparable with studies evaluating the impact of individual counseling.[13,25,26] Web-based interventions are available to patients remotely through any Internet browser and may consist of a home page linking participants to addiction treatment services, self-selected modules, and peer discussion forums. In a meta-analysis by Riper and colleagues,[27] Web-based interventions used by participants in community settings (eg, home, employment) targeting alcohol use showed a small but significant effect (g 5 0.20; 95% confidence interval [CI], 0.13–0.27; $P<.001$).

The effect of Web-based interventions is potentiated when delivered in multiple sessions at home or in specialty addiction treatment settings.[28,29] Findings in a systematic review by Riper and colleagues[28] reported higher effect sizes in multi-session modularized Web-based interventions (g 5 0.61, 95% CI 0.33–0.90) targeting alcohol use in community settings (eg, home, library, work) compared with single-session personalized feedback programs (g =

0.27, 95% CI 0.11–0.43, $P = .04$). Kay-Lambkin and colleagues[30] described equivalent treatment outcomes among participants recruited from primary care and mental health settings with major depressive disorder and problematic alcohol use (>4 drinks per day for men or >2 drinks per day for women) or at least weekly marijuana use randomized to a computer-based motivational interviewing (MI)/CBT intervention (SHADE [self-help for alcohol and other drug use and depression] therapy) versus therapist-delivered MI/CBT sessions. Bickel and colleagues[31] also reported comparable weeks of continuous opioid and cocaine abstinence and significantly greater weeks of abstinence among patients enrolled in buprenorphine maintenance treatment in a university-based research clinic receiving a computer-assisted intervention grounded in the CRA combined with contingency management versus standard treatment (CRA-based in-person counseling plus contingency management). CRA reinforces the client's motivation and coping strategies to reduce substance use and integrate social, recreational, and vocational reinforcers to avoid substance use.[32] CM is based on operant conditioning and offers a system of incentives to enhance patient motivation for abstinence.[33] Carroll and colleagues[34] reported that individuals recruited from a community-based outpatient addiction treatment program who met Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition criteria for alcohol, cocaine, opioid, or marijuana dependence randomized to a CBT-based computer intervention (CBT4CBT) showed similar rates of treatment retention compared with standard treatment; further, participants assigned to the CBT4CBT program provided significantly more negative urine drug screen tests and longer continuous durations of abstinence.[35]

Subsequent studies assessed the impact of substituting portions of in-person counseling with Web-based interventions to reduce the burden on health care personnel while ensuring improved therapeutic support and clinical outcomes. Marsch and colleagues[36] evaluated the effectiveness of the Therapeutic Education System (TES), a Web-based psychosocial intervention constituted of modules grounded in the CRA and CBT models among methadone maintenance treatment patients (N = 160) randomized to standard treatment or TES partially substituting for in-person counseling. Findings showed significantly higher rates of abstinence among participants receiving the TES (48%) compared with standard treatment (37%) across all study weeks ($P<.05$). Notably, participants exposed to the TES system showed less dropout compared with patients receiving only clinician-delivered treatment (log-rank $P = .017$) and were exposed to a higher "dose" of the psychosocial intervention.[36] Postal and colleagues[37] assessed the effectiveness of the Alcohol de Baas intervention, a Web-based platform integrating CBT to reduce alcohol use and problem drinking behavior, and improve health status. Participants were recruited from the community and showed significantly improved health status and abstinence, reduced problem drinking, and higher readiness to initiate alcohol treatment compared with the control group. At 6 and 9 months, weekly consumption was less than baseline and participants showed significant improvements in depression, anxiety, and stress scores.[38]

Campbell and colleagues[39] evaluated the effectiveness of the TES, consisting of 62 interactive multimedia modules (eg, basic cognitive-behavioral relapse prevention skills; improving psychosocial functioning; and prevention of HIV, hepatitis, and sexually transmitted infections) requiring approximately 30 minutes each to complete. Interactive

modules substituted for 2 hours of standard clinician-led group therapy sessions per week. Incentives were earned by participants for negative urine or alcohol breathalyzer screens and TES module completion, and redeemed using the TES platform to reduce high dropout and relapse rates in the early stages of treatment. Nearly half of the draws consisted of supportive content (eg, “Good job”), and the remaining draws rewarded participants with prizes worth $1, $20, or $80 to $100 in decreasing probability. Participants in the TES group had a significantly greater abstinence rate (odds ratio, 1.62; 95% CI, 1.12, 2.35), and improved retention in treatment (log-rank $P = .017$).[39]

Findings from these trials show the effectiveness of Web-based TES interventions targeting SUDs while overcoming administrative and clinical barriers limiting the reach of evidence-based psychotherapeutic interventions in diverse specialty addiction treatment settings.[39] The applicability of similar Web-based TES interventions across traditional primary care settings remains promising and requires further implementation studies to inform TES integration into service delivery.

Text Message–Based Interventions

Less technologically complex compared with computer-based, Internet-based, or smartphone-based interventions, text messaging (TM) remains a cost-effective platform for improving chronic disease management in primary care (eg, smoking cessation, appointment adherence, and adherence to antiretroviral therapies).[19,40,41] It is the most popular mobile phone feature nationally among patients in addiction treatment and in primary care.[12,42] TM may deliver multimedia content (eg, images, videos, audio) and incorporate behavior change approaches, including CBT, and motivational interventions, with high fidelity.[12]

Recent systematic reviews have described the feasibility and preliminary efficacy of TM interventions to reduce the burden of alcohol and illicit substance use in primary care and university-based research clinic settings. Studies indicate improved retention in treatment; medication adherence; and reduced alcohol, methamphetamine, and opioid use.[12,18,35,36] Stoner and colleagues[43] randomized participants with alcohol use disorder to a text-based tool providing medication reminders for oral naltrexone, adherence support, and prompts eliciting potential side effects, cravings, and alcohol use versus the control condition (i.e., receipt of a prepaid phone and prompts for alcohol use and related side effects). Although adherence to naltrexone did not predict drinking outcomes, the intervention group reported significantly longer periods of adherence to naltrexone (mean = 19 days; 95% CI, 0.0–44.0) than those in the control group (mean = 3 days; 95% CI, 0.0–8.1) during the first month of treatment ($P = .04$).

Researchers have also leveraged TM to enhance appointment adherence,[44] self-efficacy, relapse prevention, social support, and linkage with peer support groups.[45] Gonzales and colleagues[46] described significantly improved participation in extracurricular recovery activities, rates of abstinence, and reduced substance use problem severity among young adults (aged 12–24 years) recruited from outpatient and residential treatment programs randomized to TM-based self-monitoring prompts, educational content, and information regarding social support resources. TM tools may also enhance access to health care providers in real time to reduce the risk of relapse or other adverse events. Lucht and

colleagues[47] randomized participants completing inpatient detoxification for alcohol and scheduled to follow-up in outpatient addiction treatment with a TM intervention offering as-needed counselor tele-phone support and showed significantly improved rates of low-risk alcohol use, treatment retention, and later episodes of relapse compared with standard care.

TM interventions have also addressed clinical barriers to managing SUDs in primary care, including the management of comorbidities prevalent in patients with SUDs (ie, HIV, depression).[48,49] Agyapong and colleagues[48] randomized dual-diagnosis participants with alcohol use and major depressive disorder to a twice-daily supportive TM tool in combination with primary care. TM content was designed to reduce cravings, stress, relapse, and nonadherence to medications, and to provide general support. Although there were no significant improvements in depression symptoms, participants randomized to the TM tool showed increased days to first drink.

Interactive Voice Recognition

Outpatient management of SUDs requires close monitoring of daily substance use, medication adherence, cravings, and adverse events. Similar to TM, Interactive voice response (IVR) offers a seamless approach to enhance between-visit patient engagement with care. IVR technology uses a telephone-delivered system of recorded scripts to persons seeking substance use treatment. IVR automatizes scheduled phone calls to elicit participant responses in real time using telephone keypad responses or voice recognition, which is preferable for certain patient subgroups that are less comfortable with TM or with limited literacy skills.[50] More dynamic IVR systems include automatic logical skipping or branching sequences to offer more user-centered feedback. Notably, some patients report increased comfort reporting sensitive information to the IVR system than to their clinician.[51] IVR has also shown an impact on chronic illness management outcomes (blood pressure and glycemic control),[51] but the clinical efficacy of IVR in reducing substance use (other than cigarette use)[52] remains unclear.[53–55]

Smartphone Applications

The near ubiquity of mobile phones and increasing popularity of smartphone owner-ship has hastened the development and study of mobile phone–based health interventions to reduce the burden of SUDs. Smartphone applications offer a diverse range of functions with advanced software capabilities to enhance chronic illness management. The effectiveness of smartphone applications has been supported in recent trials among participants with alcohol use disorder in specialty addiction treatment settings. Dulin and colleagues[56] conducted a pilot randomized controlled trial to evaluate the clinical impact of a stand-alone, self-administered smartphone-delivered intervention for participants recruited from the community with alcohol use disorder (ie, drinking a minimum of ≥14 drinks for women or ≥21 drinks for men per week over a consecutive 30-day period and ≥2 heavy drinking days consisting of 4 or more drinks for women and 5 or more drinks for men in the same 30-day period) who were not enrolled in specialty addiction treatment. The intervention modules enhanced patient awareness of their drinking problems, assessment of daily alcohol use, triggers, personalized weekly feedback reports, and reinforcement of users' social support networks. These features were coupled with offering users coping strategies to reduce

cravings and psychological distress to reduce the risk of drinking. The intervention reduced the number of hazardous drinking days and numbers of drinks per day. These preliminary findings suggest clinical benefit for stand-alone evidence-based interventions for individuals unable to access specialty treatment and require further study for potential adoption in primary care.

More recently, Gustafson and colleagues[23] examined the effectiveness of A-CHESS (Alcohol – Comprehensive Health Enhancement Support System) among participants transitioning from residential alcohol treatment to outpatient treatment. A-CHESS is based on self-determination theory[57] and cognitive-behavioral relapse prevention[58] to enhance perceived competence, social relatedness, and motivation to reduce alcohol use. This multifeatured smartphone intervention offers self-assessments, discussion groups, counselor support, links to online resources on addiction management, GPS (global positioning system) tracking to prompt patients if they approach a high-risk location that may lead to relapse, and personalized therapeutic goals. Patients randomized to A-CHESS showed significantly fewer risky drinking days (mean difference, 1.37; 95% CI, 0.46–2.27; $P = .003$), and increased abstinence in the previous 30 days at months 8 and 12 ($P = .04$ and .02), compared with patients receiving treatment as usual, and sustained engagement with the application.[23]

Online Forums and Social Media

Online platforms (eg, discussion/chat rooms, e-mail threads, social media) offer anonymous and socially supportive communication that reinforces self-management, self-esteem, and assistance linking with treatment.[59] Twelve-step–based online sites remain the most popular among participants with SUDs. In addition, an increasing number of sites offer alternatives to the 12-step approach (eg, Women For Sobriety, Rational Recovery Center, SMART [Self-Management and Recovery Training] recovery, Rational Emotive Behavior Therapy). The popularity, quality of information, and clinical impact of such online forums as yet remains unclear.[20] However, given the effectiveness of in-person peer support as an adjunct to primary care–based approaches to managing SUDs,[60] similar online forums based on the 12-step or SMART recovery model have the potential to also enhance clinician-delivered interventions in primary care for SUDs. There are also hundreds of commercial online sites and social media pages promising access to therapists, peer support networks, and motivational and informational content. Sites accredited by the Joint Commission on Accreditation of Healthcare Organizations (eg, soberrecovery.com) may assist some patients in accessing potentially beneficial content (Table 2). Recent National Institutes of Health funding of research that leverages social media and online forums promises to reveal important insights into these diversifying platforms facilitating recovery.[61]

Emerging Technologies

In addition to the TBIs reviewed earlier, there are also several emerging technologies that are likely to have an impact on SUD treatment in the years ahead. Technological advances have been rapid over the last decade, resulting in smaller, faster devices with increased computing power. In addition, wireless communication between devices can allow real-time information gathering and transfer between patients and providers. Further, relevant data that

extend beyond alcohol and drug use (eg, heart rate, tone of voice) can be processed with machine learning approaches that can ultimately lead to the ability to predict patient behaviors. These novel technological approaches coupled with existing theoretically informed TBIs have the potential to increase the reach and efficacy of SUD treatment (Table 3).

Advances in biosensor technology have contributed to the emergence of novel interventional approaches. To date, the most work has been conducted with transdermal alcohol sensors such as the commercially available Secure Continuous Remote Alcohol Monitoring device (SCRAM; Alcohol Monitoring Systems, Inc, Littleton, CO). SCRAM takes measurements every 30 minutes and is able to wirelessly convey transdermal readings to a remote server. Although frequently used in the criminal justice system, SCRAM, especially in conjunction with contingency management interventions, has resulted in promising drinking outcomes among outpatients engaged in alcohol treatment.[62–64] Other transdermal sensors include the WrisTAS (Giner, Inc, Newton, MA). The WrisTAS, unlike the SCRAM, is worn on the wrist and takes measurements every minute and has shown high sensitivity and specificity.[65]

Other emerging technologies have focused on the ability to obtain real-time feed-back, thereby increasing the potential to intervene more promptly. Examples of this include technological approaches for monitoring medication adherence. The Wisepill device (Wisepill Technologies, Cape Town, South Africa), the size of a pack of cards, stores pills, tracks when the device has been opened, and wirelessly sends information to an external server (eg, to a researcher or clinician). In addition, the Wisepill device can also be paired with text message reminders to help facilitate patient adherence. The Wisepill device and messages have been used successfully to increase adherence to antiretroviral therapy in patients with HIV and has been used to monitor naltrexone adherence in methamphetamine users and binge drinkers.[66,67] Because of concerns about whether patients actually ingest a medication when opening such monitoring devices, researchers have explored the use of inert radiofrequency emitters attached to the medication to create an ingestible digital pill that communicates with a cloud-based server while in the stomach.[68,69] Another real-time monitoring approach involves the use of a Soberlink device (Soberlink, Inc, CA), equipped with facial recognition software to verify identity, that allows patients to provide breath sample data on breath alcohol levels, which are wirelessly sent to treating providers.[70] The clinician is then able to promptly respond to positive results and provide the patient who continues to drink with appropriate intervention. Alternatively, others have explored pairing breathalyzer results with a smartphone app to provide feedback and encourage skill building.[71]

Although the technologies described earlier involve obtaining objective information on alcohol and drug use from patients, there are several emerging technologies that can be used to predict potentially risky behaviors before they happen. For example, Boyer and colleagues[72] (2012) argued that, in concert, technologies including artificial intelligence, continuous physiologic monitoring, wireless connectivity, and smart-phone computation would be able to detect when an individual is experiencing craving for alcohol or drug use and could receive a just-in-time intervention to prevent sub-stance use. Acute changes in negative affect and craving (known risk factors for relapse) are associated with concomitant

changes in physiologic arousal; namely, heart rate and electrodermal activity (EDA).[73–76] Both research-grade devices and commercially available smartwatches that communicate wirelessly with smartphones are equipped with medical-grade biosensors that provide continuous monitoring of heart rate, temperature, and EDA. Physiologic data that include EDA and temperature, measured by a portable biosensor wristwatch (Q sensor; Affectiva, Waltham, MA), have been shown to be associated with cocaine and opiate use in both laboratory and ambulatory environments.[77,78] Work is currently underway to identify drug use cravings and, through machine learning approaches, develop algorithms for predicting drug use so that personalized relapse prevention interventions can be delivered during the time of greatest need.[72]

Machine learning approaches have also been proposed to aid in the prediction of whether an individual is intoxicated. For example, Arnold and colleagues[79] argue that data collected from the smartphone accelerometer and gyroscope (called Alcogait) coupled with information on how much an individual has consumed alcohol could, through machine learning, reliably predict blood alcohol levels. In doing so, when this information can be used to deliver feedback to an individual about their ability to drive, for example, alcohol-related risk behaviors may be decreased or avoided.

These emerging technologies can be integrated into individuals' everyday lives, with passive collection of data that can be computationally processed for available feedback to the at-risk individual, without much additional effort from the individual. As these technologies enter the next stage of experimental investigation and efficacy testing, clinicians will have a greater understanding of their impact on reducing the overall public health risk associated with SUDs.

IMPORTANT CONSIDERATIONS RELATED TO TECHNOLOGY-BASED INTERVENTIONS FOR SUBSTANCE USE DISORDERS

Technology-Based Interventions for Dual-Diagnosis Populations

Comorbid SUD and psychiatric disorder is common. Although efforts have been made to address psychiatric comorbidity in patients with SUD, few treatments exist that effectively address multiple comorbidities. Because individuals with comorbid disorders experience more treatment access barriers, including social deficits and stigma,[80] the use of TBIs in dual-diagnosis populations may be a particularly effective strategy.

In a recent systematic review of TBIs for substance use and comorbid disorders, Sugarman and colleagues[81] (2017) identified only 9 studies, with the largest number being for depression comorbidity. The TBI with the most empirical testing has been the SHADE, a 9-session MI plus CBT computer-delivered intervention that has shown reduction in alcohol and cannabis use as well as decreases in depressive symptoms.[82] An abbreviated version of SHADE has been developed for young adults with alcohol and depressive comorbidity, called DEAL.[83] Short-term decreases in drinking and depression were found but not sustained, and adherence to the intervention was challenging. There is an ongoing study of DEAL that adds a social networking component for depressed, binge drinking young adults.

[84] There are also several studies examining TBIs for individuals with comorbid trauma experiences and SUDs, with or without a diagnosis of posttraumatic stress disorder. In a recent review of these studies, Gilmore and colleagues[85] (2016) found that TBIs are feasible for this population and are likely to be efficacious in reducing either trauma symptoms or substance use.

As reported by Sugarman and colleagues[81] (2017), there are several special considerations when developing and testing TBIs for a dual-diagnosis population. First, the more effective interventions tend to be longer and more intensive. Adherence to the intervention is therefore a challenge and the investigators suggested that financial incentives, gamification of TBIs, and some clinical involvement may be necessary to increase engagement with the intervention. Also, because there is always a concern for clinical deterioration and suicidal ideation, there is a need to consider strategies for incorporating clinical monitoring in the delivery of TBIs in dual-diagnosis patients.

Factors Influencing the Fidelity of Technology-Based Interventions

If well-designed, TBIs can minimize the burden on delivery systems and reduce net spending for SUDs while expanding the use of underused addiction pharmacotherapies and psychosocial interventions. Translating evidence-based TBIs into main-stream health care settings will rely on a reorganization of clinical practices that consider patient-level factors to sustained engagement with emerging platforms (eg, socioeconomic and clinical barriers to care), privacy and regulatory concerns, on-boarding delivery systems and providers that have limited experience with TBIs, and reimbursement mechanisms.[24,86]

Patient-level barriers to treatment entry for SUDs (eg, race/ethnicity, socioeconomic status, less education, impaired cognition, severe mental illness)[8,80] mirror the barriers to access to mobile phones, computers, and Internet.[19,87,88] However, offering free mobile phones or in-clinic access to computers ensures open access to evidence-based interventions and improved clinical outcomes (eg, cognitive functioning, abstinence, and treatment retention).[12,23,49,89,90] Additional strategies for dissemination of evidence-based TBIs include subsidizing Internet or mobile phone plans, offering instructions on intervention use, and tailoring intervention content and design features to user preferences.

The spread of unvalidated, commercially driven smartphone applications, social media pages, and Web-based interventions has dampened the dissemination of effective TBIs. Developers often claim medical expertise and offer unsubstantiated claims of intervention efficacy, and may sell user data to third parties for commercial use.[91] The monetization of digital data and risks for compromised patient health information require clinicians to caution patients regarding commercially driven TBIs. The US Food and Drug Administration (FDA) has increased oversight of emerging TBIs, including mobile medical applications but may have difficulties in regulating product claims unrelated to specific medical conditions (eg, promotes reduced stress, concentration, behavior control).[92] Nonetheless, clinicians should help patients navigate the marketplace by confirming device approval via the FDA (eg, https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfRL/rl.cfm) and existing literature.

Privacy and Regulatory Considerations to Technology-Based Intervention Integration

Adoption of effective TBIs in mainstream and addiction treatment settings remains slow because concerns over social, legal, and ethical implications remain unanswered. Potential issues for patients and providers include:

1. Open access to indefinitely stored content in mobile phones, emails, IVR platforms, online forums, or mobile sensors requires protocols for deletion
2. Inability for physicians or patients to confirm the authenticity of authorship of content transmitted between one another
3. Interception of content exchanged between providers and patients
4. Lack of familiarity with the Health Insurance Portability and Accountability Act (HIPAA)[93]

Risk management of compromising patient health information includes the removal of any patient's identifiers or stigmatizing content (eg, HIV, addict, methadone), restricting patient contact to only 1 provider or software, password protecting all mobile phones and devices, obtaining security certifications from mobile phone service providers, using encryption technologies for transmitted content, and regularly deleting transmitted content.[24,93]

Clarifying Intervention Design and Clinical Impact

Interventions that are overly complex, contain redundant or ineffective components, and seem homogenous can lead to a reduction in treatment efficacy with every type of intervention. To preempt such problems, software that incorporates graded approaches, such as adjusting the frequency of TM prompts based on the patient's clinical condition and level of responsiveness with the intervention, sustains engagement during the different stages of recovery.[12,49] In addition, intervention development based on mixed-methods research and usability testing (eg, intervention mapping approach, multiphase optimization strategy testing) improves the reach, long-term engagement, and effectiveness of newly introduced platforms.[12,94,95] Meta-analysis and recent reviews have also found that integrating patient-tailored design features and effective psychosocial interventions enhances engagement with the TBI, is associated with greater effect sizes, and optimizes behavior change and clinical out-comes.[12,13,18,96] In addition, linking TBIs with immediate access to health care providers or supportive peers is preferable to interventions that lack any human contact because of the demotivating nature of some automated interactions.[12,18,21]

Although TBIs may be tailored to the patient's clinical needs, studies are needed to assess the appropriate level of exposure or dose of TBIs versus clinician-delivered psychosocial interventions, the effectiveness of computer-based versus mobile phone–based interventions, and smartphone-based compared with TM-based platforms. In addition, the clinical effectiveness of adding TBI-delivered psychosocial interventions to existing addiction pharmacotherapies (eg, buprenorphine, naltrexone) in traditional primary care settings remains limited.

SUMMARY

In the last 2 decades, advances in TBIs addressing SUDs, most often in addiction treatment settings, have made possible effective point of service data gathering, adherence management, reinforcement of evidence-based psychosocial interventions, improved patient-physician communication, retention in office-based treatment, and increased abstinence with minimal disruption to health care personnel and clinical workflow. For TBIs to reach their full potential to reduce the burden of SUDs, strategies are needed to facilitate their dissemination and implementation in primary care: addressing clinician adoption of TBIs, financial reimbursement, adaptability of hardware in primary care, integration and interoperability, and user engagement.[97]

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KEY POINTS

- The burden of alcohol and drug use disorders (substance use disorders [SUDs]) has intensified efforts to expand access to cost-effective psychosocial interventions and pharmacotherapies.
- This article provides an overview of technology-based interventions (eg, computer-based and Web-based interventions, text messaging, interactive voice recognition, smartphone apps, and emerging technologies) that are extending the reach of effective addiction treatments both in substance use treatment and primary care settings.
- This article discusses the efficacy of existing technology-based interventions for SUDs, prospects for emerging technologies, and special considerations when integrating technologies in primary care (eg, privacy and regulatory protocols) to enhance the management of SUDs.

Table 1

Published data on technology-based interventions for substance use disorders

Reference	Device	Target Substances	Target Behaviors or Behavior Change Model	Contact Information
Carroll, et al,[34] 2008	Internet/Web	Alcohol, cocaine, opioid, cannabis	CBT	http://www.cbt4cbt.com/
Marsch et al,[36] 2014	Internet/Web	Opioids	CRA, CBT	http://www.c4tbh.org/
Postel et al,[37] 2010	Internet/Web	Alcohol	CBT, biopsychosocial model	www.lookatyourdrinking.com
Campbell, et al,[38] 2014	Internet/Web	Alcohol, cocaine,, cannabis, opiates, stimulants	CRA	http://sudtech.org/
Stoner et al,[43] 2015	Text message	Alcohol	Adherence to oral naltrexone	sastoner@uw.edu
Dulin et al,[56] 2013	Smartphone app	Alcohol		http://stepaway.biz/
Gustafson et al,[23] 2014	Smartphone app	Alcohol	Self-determination theory, cognitive-behavioral relapse prevention	https://chess.wisc.edu
Kay-Lambkin et al,[82] 2011	Internet/Web	Alcohol	Depression	http://www.shadetreatment.com/

Abbreviations: CBT, cognitive behavior therapy; CRA, community reinforcement approach.

Table 2

Online support forums

Program	Web Site
Sober Recovery	www.soberrecovery.com/forums/
12 Step Recovery Forums	www.12stepforums.net
Women for Sobriety	womenforsobriety.org
Rational Recovery	rational.org
SMART Recovery	https://www.smartrecovery.org/community/forums/6-Tools-and-Discussions

Abbreviation: SMART, Self-Management and Recovery Training.

Table 3

Emerging technologies

Secure Continuous Remote Alcohol Monitoring Device (Alcohol Monitoring Systems, Inc)	Sensor	(1) Alcohol	www.scramsystems.com/
WrisTAS (Giner, Inc)	Sensor	(1) Alcohol	www.ginerinc.com/wristtransdermal-alcoholsensor
Wisepill device (Wisepill Technologies)	Pillbox plus smartphone app	(1) Medication adherence	www.wisepill.com
Soberlink device (Soberlink, Inc)	Portable breathalyzer	(1) Alcohol	www.soberlink.com/