Published in final edited form as:
Psychiatr Clin North Am. 2012 June ; 35(2): 481–493. doi:10.1016/j.psc.2012.03.009.

Advances in the Psychosocial Treatment of Addiction:

The Role of Technology in the Delivery of Evidence-Based Psychosocial Treatment

Lisa A. Marsch, Ph.D.[a]**[Director]** and **Jesse Dallery, Ph.D.**[b]**[Associate Professor]**

Lisa A. Marsch: Lisa.A.Marsch@Dartmouth.edu; Jesse Dallery: dallery@ufl.edu

[a]Center for Technology and Behavioral Health; Dartmouth Psychiatric Research Center; Department of Psychiatry; Dartmouth College; Rivermill Commercial Center; 85 Mechanic Street; Suite B4-1; Lebanon, NH 03766; Voice: 603-448-0263, ext. 147; Fax: 603-448-3976

[b]Department of Psychology, University of Florida, PO Box 112250, Gainesville, FL 32611, Voice: 352-273-2182; Fax: 352-392-7985

Synopsis

The authors present an overview of empirically supported psychosocial interventions for individuals with substance use disorders (SUDs), including recent advances in the field. They also identify barriers to the adoption of evidence-based psychosocial treatments in community-based systems of care, and the promise of leveraging technology (computers, web, mobile phone, and emerging technologies) to markedly enhance the reach of these treatments. Technology-based interventions may provide “on-demand,” ubiquitous access to therapeutic support in diverse settings. A brief discussion of important next steps in developing, refining, and disseminating technology-delivered psychosocial interventions concludes the review.

Keywords

computer; psychosocial treatment; addiction; technology; mobile

Introduction

The substance abuse treatment field has made substantial gains in developing empirically supported psychosocial interventions for substance use disorders (SUDs) and co-occurring issues, such as psychiatric co-morbidities and HIV risk behavior. Although medication is indicated to treat many SUDs (e.g., opioid use disorders), providing evidence-based psychosocial interventions (e.g., prosocial life skills training, relapse prevention skills training, and HIV education) is often critical for medication treatment to be maximally effective. Furthermore, in many cases, psychosocial interventions are critical for generating important skills, attitudes, information, and motivation to promote a drug-free lifestyle. Providing evidence-based psychosocial interventions has been shown to meaningfully

Correspondence to: Lisa A. Marsch, Lisa.A.Marsch@Dartmouth.edu.

Disclosures

In addition to her academic affiliation, Dr. Marsch is affiliated with HealthSim, LLC, the health-promotion software development organization that developed the web-based Therapeutic Education System (TES) referenced in this manuscript. Dr. Marsch has worked extensively with her institutions to manage any potential conflict of interest.

improve treatment outcomes, including drug abstinence, treatment retention, psychosocial functioning, and relapse prevention. A recent meta-analysis (n=2,340) demonstrated that nearly 2.5 times as many substance-users who received evidence-based psychosocial treatment achieved post-treatment and/or clinically significant abstinence, compared to those who received non-evidence-based psychosocial treatment or no psychosocial treatment.[1]

We review the empirical support for an array of psychosocial treatment interventions targeting SUDs. [2,3,4] We discuss the barriers to widespread adoption of many evidence-based psychosocial treatments in current systems of care, and the promise of leveraging technology (e.g., computers, web, mobile phones, emerging technologies) to enhance the reach of evidence-based treatments in a manner which provides "on-demand" ubiquitous access to therapeutic support in diverse settings. We conclude with a brief description of future directions for technology-based intervention research and dissemination.

Evidence-based psychosocial interventions: Definition and challenges associated with their implementation

For the purposes of this article, we restrict our definition of evidence-based therapies targeting SUDs to those supported by randomized, controlled studies, and which also have a technology-based counterpart. These interventions include the Community Reinforcement Approach, Cognitive-Behavioral Therapy and Skills Training, Motivational Enhancement Therapy (and Motivational Interviewing), and Contingency Management. We also discuss other psychosocial interventions for co-occurring issues (e.g., comorbidities), HIV reduction strategies for individuals with SUDs, as well as other, cutting-edge technology-based platforms that do not have a comparable, in-person counterpart (e.g., Neurocognitive Remediation Strategies). Although we discuss these interventions separately, they are generally compatible with one another and often include overlapping active ingredients of behavior change.[5,6] Indeed, several psychosocial treatments have been shown to have additive effects when combined relative to when they are delivered alone.[7]

Although the evidence-base for psychosocial interventions is strong, they are infrequently provided to individuals with SUDs, even in formal systems of care such as substance abuse treatment [8,9] Cost is one of the most significant barriers to providing evidence-based, behavior change interventions. These interventions are expensive to implement and require financial and staffing resources not available to the average community-based treatment program. They can also be complex and require considerable staff training to be properly applied. Even if evidence-based interventions are initiated by treatment programs, it may be difficult to ensure their fidelity. This may be due to the significant staff turnover in many programs and/or the high patient caseloads maintained by program counselors and their limited contact time with any one patient. In addition, travel to treatment programs may be a barrier to accessing evidence-based care for many patients, especially in rural areas. Thus, the limited compatibility of research-based interventions with treatment agency realities presents numerous operational barriers to the transfer of evidence-based practice into community-based settings.

Further, the majority (90%) of persons with SUDs are not in substance abuse treatment. Nearly 21 million Americans annually remain untreated for a SUD, suggesting that the current treatment system is inaccessible or unacceptable to most substance-abusing individuals. [10] Although evidence-based interventions targeting SUDs could be embedded within other systems of care, including an array of medical settings (e.g., emergency rooms, primary care, health clinics) and/or criminal justice settings (e.g., probation and parole, jails, prisons), they are infrequently provided in such settings. Challenges to delivering evidence-based care in these settings are similar to challenges to delivering these interventions in

substance abuse treatment settings, and include limited training, time and (sometimes) interest among providers to deliver such interventions. As the availability of trained clinicians is limited and many individuals do not seek out traditionally-delivered interventions, offering a "toolkit" of technology-based interventions as alternative or complementary therapeutic tools targeting SUDs and related issues holds promise to markedly impact these behavioral health issues.

Harnessing technology to deliver evidence-based psychosocial interventions

We briefly review the empirical support and conceptual underpinnings of psychosocial treatments and, for each intervention, we discuss how the intervention has been translated into a technology-based platform. Although a few technology-based programs reviewed have an accumulating body of empirical support from numerous randomized, controlled trials, some of these technology-based platforms are still in the development and early testing phase. Thus, the evidence base for these programs varies across programs and further work is still needed to test these interventions using scientifically rigorous research designs. [11]

The Community Reinforcement Approach (CRA)

CRA is grounded in research related to drug self-administration and a behavioral analysis of drug dependence. Drugs are viewed as competing successfully with more delayed prosocial reinforcers because of their more immediate reinforcing effects. [12,13] To address this, the skills training component of CRA teaches skills and encourages behaviors that increase non-drug sources of reinforcement (e.g., prosocial activities) and shares many common elements with other evidence-based, cognitive behavioral and relapse prevention behavioral interventions for SUDs. CRA has been shown to be highly effective in the treatment of a variety of adult substance-abusing populations. [14,15,16] CRA is also highly efficacious in adolescent populations. [17] Compared to a number of other behavioral therapy and family-based approaches, the Adolescent Community Reinforcement Approach (A-CRA), which largely targets youth but also includes a parent component [18], produced among the highest rates of abstinence (72% total days abstinent) and was demonstrated to be the most cost-effective.[15]

Therapeutic Education System (TES)

The principles underlying CRA were translated into a technology-based intervention, the Therapeutic Education System (TES), which is the first web-based psychosocial treatment program for individuals with SUDs evaluated in systematic scientific research. This interactive program is composed of 65 modules with an optional, computerized contingency management component (see below). [19] These modules include targeting cognitive behavioral skills (refusal skills, managing harmful thoughts, etc.), improving psychosocial functioning (family/social relations, managing negative moods, etc), and reducing behavior that may place one at risk for HIV, hepatitis or sexually transmitted infections. TES is self-directed, includes functionality to build individualized treatment plans, assesses a patient's grasp of material, and adjusts the pace and level of repetition of material to promote skills mastery. It also includes interactive videos to help patients learn behaviors (e.g., progressive muscle relaxation). Randomized trials have found that TES: [17, 20, 3]

1. produced outcomes superior to standard substance abuse treatment
2. improved objectively measured drug abstinence comparable to rates produced by highly trained clinicians delivering comparable therapy

3. improved HIV/prevention knowledge and intentions to reduce HIV risk behavior
4. is highly acceptable to an array of SUD audiences

Cognitive Behavioral Therapy (CBT) and Skills Training Therapies

Cognitive behavioral approaches have been shown to be effective in a variety of drug-using populations including cocaine [21] and alcohol users [22], as well as in adolescents [23] and individuals with a variety of psychiatric disorders. [24] Broadly, these interventions seek to modify relations between environmental and cognitive antecedents of problem behavior ("risk factors") and problem behavior such as drug use. These interventions also focus on skill building, such as developing problem solving, coping, and refusal skills. The skill building features of these interventions may be important in achieving abstinence from the target drug, as well as in addressing other co-occurring problems in patients' lives. Indeed, there is some evidence that effects following cognitive behavioral and skills building therapies are long-lasting, and continued improvement is evident even one year post-treatment. [25, 26]

A largely video-based, computer-delivered CBT intervention, the Computer-based Training in Cognitive Behavioral Therapy (or CBT4CBT) program, was developed by Carroll and colleagues. [27] This 6-session program employs key CBT content (e.g., understanding one's patterns of substance use; improving coping skills and decision-making skills). CBT4CBT was found to significantly enhance treatment outcomes when provided as an adjunct to traditional substance abuse treatment [25] and showed promise for cost-effectiveness. [28] Participants also demonstrated significantly enhanced coping skills from the CBT4CBT intervention. [29]

Motivational Interviewing and Motivational Enhancement Therapy

Motivational Interviewing (MI) and Motivational Enhancement Therapy (MET) are client-centered, semi-directive methods designed to help individuals explore and resolve ambivalence about change and reinforce behavior change. [30] MI is typically a brief intervention, usually one session in length, which may be provided as a stand-alone intervention or as part of the beginning of a treatment episode. MET uses MI principles but is typically a slightly longer intervention (up to about four sessions).[6] A recent Cochrane review concluded that MI significantly impacts substance use compared to no treatment controls but that effects decay over time. [31] Additional research has demonstrated that MI may be particularly effective in strengthening engagement in more intensive addiction treatment. Further, MET has been shown to generally be as effective as other common psychosocial treatments for SUDs. [32]

Several technology-delivered interventions have been developed to deliver MET and MI targeting SUDs. Ondersma and colleagues (2005) developed the Motivational Enhancement System, initially designed to give feedback, assess readiness to change, explore the pros and cons of change, and encourage goal-setting to postpartum women who reported substance use before pregnancy. This program has been shown to be highly acceptable and improve motivation to reduce substance use [33] as well as reduce actual substance use among postpartum women. [34] Ondersma and colleagues demonstrated similar effects with a brief MET/MI intervention targeting smoking among pregnant women. [35]

Another web-based MET/MI intervention has been shown to reduce drinking in several groups with problematic drinking, including heavy drinking college students and non-dependent problem drinkers. [36,37,38] This program has also been recently modified for, and shown promise with, military populations. [39]

Contingency Management

Numerous studies over the past 25 years have established the broad applicability and versatility of Contingency Management (CM) procedures. [40, 41, 42] In this treatment, incentives are provided to individuals contingent on a target behavior (e.g., biochemical confirmation of drug abstinence). These tangible incentives enable immediate, positive reinforcement (e.g., recreational items, retail goods or services) for drug abstinence. Thus, the conceptual model underpinning this intervention is quite similar to the model described above in the section on CRA. Contingency management interventions have been shown to promote abstinence from cocaine use [43], cocaine use among methadone-maintained patients [44], heroin use [45] and polydrug use [46,47]. Contingency management has also been found to exert powerful and precise control of cigarette smoking in both adults and adolescents. [48,49] Further, contingency management has been provided along with CRA, and both components have been shown to independently contribute efficacy to the combined intervention. [7] Recently, contingency management has also been extended to promote medication adherence in a variety of populations, including promoting medication adherence in substance abusing HIV patients. [50, 51]

Internet-based CM interventions

Several researchers have leveraged technology for the delivery of evidence-based CM interventions targeting SUDs. Dallery and colleagues developed and evaluated an Internet-based CM intervention (M tiv8) targeting smoking cessation. [52,53] In this model, smokers use web-cameras to record themselves blowing into carbon monoxide (CO) detectors to provide objective evidence of smoking behavior or abstinence (by meeting targeted CO levels). Reinforcement (e.g., incentives, money) was then delivered immediately to individuals who met targeted CO levels. Results have demonstrated that Internet-based CM can promote smoking cessation in heavy, rural, and adolescent smokers. [54] The Internet-based CM model has been extended to incorporate an up-front deposit by the participant.[55] The deposit can be earned back based on evidence of abstinence, and as such it may represent a feasible way to offset costs associated with CM interventions. The Internet-based CM model has also been extended to include group contingencies, where small groups of smokers work together to achieve cessation goals to receive incentives.[55] Participants provide encouragement, feedback, etc via a discussion board integrated into the Motiv8 architecture. The group contingency model could aid in the sustainability of the intervention without an increase in costs.

Additionally, Silverman and colleagues have applied a web-based CM intervention to provide incentives for drug abstinence and workplace performance among chronically unemployed individuals with SUDs in a Therapeutic Workplace. Briefly, to gain access to the workplace, each day patients were required to provide a urine specimen that tested negative for drugs (e.g., cocaine, opiates, alcohol). If the specimen tested positive, they were not allowed to work that day. Those who gained entrance received basic skills education and job skills training, and at the end of the shift they received a voucher which could be exchanged for goods and services. This Therapeutic Workplace model [56,57] has strong empirical support and demonstrates how a technology-based system can produce long-lasting, sustainable effects. [58]

Psychosocial Interventions for Co-Occurring Issues

Psychiatric comorbidity, including personality disorders, depression, anxiety, and family dysfunction, are prevalent among individuals with SUDs. [59] Providing employment, family counseling, psychiatric services, and patient education services (e.g., prosocial life skills training) as part of treatment, is often critical for treatment to be maximally effective. In one

elegant and striking demonstration of the role of psychosocial interventions in methadone maintenance therapy [60], patients were randomly assigned to receive:

1. methadone only at doses of 60 mg or higher with no other services
2. the same doses of methadone plus counseling
3. the same doses of methadone plus counseling and onsite medical/psychiatric, employment, and family therapy

Results indicated that 69%, 41% and 19% of patients in each of these three conditions had unremitting use of opiates or cocaine, respectively, demonstrating convincingly that the quantity and quality of psychotherapeutic interventions targeting co-occurring issues markedly impact patient outcomes.

Kay-Lambkin and colleagues (2009) developed a computerized intervention targeting co-occurring depression and substance use (with a particular focus on alcohol and cannabis). This 9-session program highlights the relationship between these co-occurring issues and teaches CBT skills using an MI therapeutic style. This program has been shown to produce greater effects on depression and substance use relative to both a brief MI intervention and supportive counseling and to generally produce equivalent outcomes to comparable therapy delivered by clinicians. [61,62]

Mobile Psychosocial interventions Targeting SUDs

Although the development and scientific study of psychosocial treatment interventions targeting SUDs delivered on mobile phones is a less well developed area of research, early work in this field is promising. Marsch and colleagues developed and evaluated a prototype of a mobile phone-based psychosocial support program for individuals in substance abuse treatment and showed that providing this mobile intervention, as a supplement to standard substance abuse treatment, markedly impacted treatment outcomes.[20] In addition, Gustafson and colleagues developed ACHESS, a mobile phone-based recovery support tool for individuals in recovery from SUDs. [63] ACHESS provides tools for personalized monitoring and support to individuals in their recovery effort and may be a valuable relapse prevention aid.

HIV risk reduction

Substance abusing individuals engage in high-risk behaviors, such as sharing injection equipment and/or risky sexual behavior associated with drug use, including engaging in unprotected sex, sex with multiple partners, and sex work, that may place them at risk for infection with HIV and other infectious diseases. [64] Several studies have demonstrated that behavior therapies targeting substance use can reduce HIV risk behaviors. [65, 66] A number of effective HIV prevention interventions for both adults and adolescents with SUDs exist, and typically target HIV-related sexual and drug-use behaviors. [67, 68] Such programs are typically designed to increase accurate knowledge about HIV and teach skills that promote preventive actions that provide effective deterrents against infection, increase individuals' intentions to reduce risk behavior and communicate about condom use with partners, improve attitudes toward condom use and safer sex, increase individuals' self-efficacy/ ability to effectively use condoms, and reduce their perceived invulnerability to HIV, as these variables are strongly predictive of progression to consistent condom use and safer sex.

Several technology-delivered HIV education and prevention programs have been developed for/evaluated with individuals with SUDs.[69] Several such programs have been shown to be highly acceptable and effective as part of substance abuse treatment in promoting high levels

of HIV prevention knowledge and reductions in HIV risk behavior among injection drug users [70] as well as adolescents with substance use disorders. [71]

Computerized Neurocognitive Remediation/Executive Function Therapy

The role of executive function and inhibitory cognitive control in the development and maintenance of addictive disorders has been increasingly well-established in addiction research. From this framework, addiction is viewed as an alteration of brain decision-making processes, where the impulsive choices and reduced cognitive control associated with drug use may be the result of the more impulsive brain system dominating the executive brain system (e.g., planning, self-control). [72, 73]

Neurocognitive remediation (sometimes called Executive Function Therapy) is based on the assumption that if cognitive functions associated with the executive system can be rehabilitated, self-control behavior may increase. [74] These interventions are delivered via computer and are designed to enhance cognitive skills through exercises that target problem-solving skills, attention, memory, and abstract reasoning. For example, in one study, cognitively impaired poly-substance abusers who received computerized cognitive rehabilitation showed improvements in cognitive performance tests and remained in treatment longer than those in a control condition. [75] In addition, interventions designed to enhance cognitive functioning among individuals with SUDs has been shown to enhance the efficiency of cognitive behavioral therapies (e.g., relapse prevention). [76]

Advantages of Technology to Deliver Evidence-based Interventions

Using technology (e.g., computers, web, mobile devices) to deliver evidence-based interventions may enable widespread dissemination to an array of audiences in diverse settings. For example, web-based interventions can be offered in the home, community organizations, schools, emergency rooms, health care providers' offices, as well as via mobile devices, and online social networks. Technology has the potential to address the challenges associated with the delivery of science-based interventions, as it allows for complex interventions to be delivered at a low cost, without increasing demands on staff time or training needs. Technology-delivered interventions can also help ensure the fidelity of intervention delivery.

In addition, the temporal flexibility of technology-based interventions may allow for "on-demand", ubiquitous access to therapeutic support, thereby creating unprecedented models of intervention delivery and reducing barriers to accessing care. Further, the anonymity afforded by technology-based interventions may be appealing to individuals when addressing sensitive topics such as substance use and other risk behavior. [77] Technology-based therapeutic tools may become increasingly important and clinically useful in light of the 2010 National Drug Control Strategy from the U.S. Office of National Drug Control Policy (ONDCP), which places a strong emphasis of cost-effective care and on integrating treatment for SUDs into other areas of health care (outside formal treatment systems) where providers may have limited expertise in treating individuals with SUDs (mental health; infectious disease management, primary care). [78] Technology-based tools are well-positioned to meet this unmet need in this new model of care.

- Nearly 80% of Americans have Internet access [79]
- 87% of Americans subscribe to mobile phone services
- Over 46% Americans participate in online social networks [80,81]
- Worldwide, there are over 1.5 billion Internet users

- Growth rate in worldwide users since 2000 has exceeded 340%.
- Over 92% of individuals worldwide subscribe to mobile phone services, with over 4 billion mobile phone subscriptions worldwide, and an average growth rate of 24% per year. [82]

Although youth remain the primary users of online social networks (e.g., 75% of persons aged 18 to 24 have an online social network site), adults are increasingly using online social networks. Indeed, the number of adults who have a social network site has quadrupled in the past 4 years, from 8% in 2005 to 46% in 2009. [83] Thus, the potential reach of innovative technological interventions offered on these platforms is enormous.

Additionally, although White (80%) Americans are more likely to use the Internet than African (72%) or Hispanic (61%) Americans, African Americans are the most active users of the mobile Internet (accessed via mobile devices). The rate of increase in the use of mobile devices to access the Internet among minority groups is twice the national average since 2007 – e.g., 141% increased use for African Americans versus the 73% average. [84] By offering interventions on a wide variety of platforms to optimally capitalize on the technology most frequently used by various target populations, technology-based interventions also offer great potential to eliminate the “digital divide” and address healthcare disparities that exist in many traditional models of care. [85]

Emerging technologies

Significant developments in technology continue to emerge and offer promise for integration into systems of health care. [86,87,88] Ubiquitous computing (ubicomp; also sometimes referred to as pervasive computing) and ambient intelligence are rapidly evolving fields in which human-computer interaction are embedded into everyday objects and activities.

Ubiquitous or pervasive computing typically refers to technologies that “weave themselves into the fabric of everyday life until they are indistinguishable from it” [89], and generally involve miniaturized mobile or embedded information and communication technologies with some degree of ‘intelligence’, network connectivity and advanced user interfaces.[88] For example, ubiquitous computing technologies may allow for the unobtrusive and objective measurement of behavioral states, biological and environmental variables in real time (e.g., via mobile computing devices and wearable sensors). Ubiquitous computing is thus composed of computational and wireless communication devices that are naturally integrated into human activity.

Ambient intelligence refers to a similar concept related to an intelligent environment or an intelligent service system surrounding individuals which anticipate, adapt to and meet users’ needs.[90]

Although these evolving technologies have only just started to be applied to the field of substance abuse and related disorders, they have significant potential for having a marked impact on the field. Indeed, as Boyer et al.[91] convincingly argues, these approaches could allow for real-time, unobtrusive psychophysiological measurement, and on-demand, continuous access to tailored support, education and interventions targeting substance abuse. For example, ubicomp tools may allow one to obtain real-time data of physiological and environmental factors that precede and follow drug use (or abstinence) and provide in-the-moment interventions responsive to these factors. [92] Additionally, ambient intelligent environments, in which environments surrounding an individual could be used to reduce risk behavior, could be used as part of relapse prevention efforts.

Conclusions

The clinical community has a growing array of psychosocial interventions with a strong evidence base available for the treatment of SUDs. Considerable opportunity exists for leveraging technology in the delivery of evidence-based interventions to promote widespread reach and impact of evidence-based care. Data from this line of research to date are promising, and underscore the potential public health impact of technology-based therapeutic tools.

To fully realize the potential of technology-delivered interventions, several areas of inquiry remain important:

1. Scientifically sound strategies should be explored to ensure technology-based interventions are optimally designed to produce maximal behavior change.[93]
2. Efficient and effective methods should be identified to integrate technology-based interventions into systems of care in a manner that is most responsive to the needs of individual users.
3. Payment, privacy, and regulatory systems should be refined and extended to go beyond electronic medical records and telehealth/distance care models, and support the deployment of technology-based systems to enhance the quality, efficiency and cost-effectiveness of care.
4. Mechanisms underlying behavior change derived from technology-based treatments should be explicated, including new mechanisms that may be tapped via novel, technology-based tools. [5,6,94] Such work will be critical in isolating mechanisms that are useful in predicting treatment response, and in ensuring that key ingredients are present in technology-based interventions as they are made widely available.

References

1. Dutra L, Stathopolou G, Basden S, et al. A meta-analytic review of psychosocial interventions for substance use disorders. Am J Psychiatry. 2008; 165:179–87. [PubMed: 18198270]
2. Bickel WK, Christensen DR, Marsch LA. A review of computer-based interventions used in the assessment, treatment, and research of drug addiction. Subst Use Misuse. 2011; 46(1):4–9. [PubMed: 21190401]
3. Marsch, LA. The Application of Technology to the Assessment, Prevention and Treatment of Substance Use Disorders: An Editorial. In: Marsch, LA., editor. Special Issue on Technology and Substance Use Disorders. Substance Use and Misuse. Vol. 46. 2011. p. 1-3.
4. Moore BA, Fazzino T, Garnet B, et al. Computer-based interventions for drug use disorders: a systematic review. Journal of Substance Abuse Treatment. 2011; 40(3):215–23. [PubMed: 21185683]
5. Moos RH. Theory-based processes that promote the remission of substance use disorders. Clinical Psychological Review. 2007; 27:537–51.
6. Moos RH. Theory-Based Active Ingredients of Effective Treatments for Substance Use Disorders. Drug Alcohol Depend. 2007; 88(2–3):109–121. [PubMed: 17129682]
7. Higgins ST, Sigmon SC, Wong CJ, et al. Community reinforcement therapy for cocaine-dependent outpatients. Arch Gen Psychiatry. 2003; 60(10):1043–52. [PubMed: 14557150]
8. Bickel, WK.; Marsch, LA. A future for the prevention and treatment of drug abuse: Applications of computer-based interactive technology. In: Henningfield, JE.; Santora, PB.; Bickel, WK., editors. Addiction treatment: Science and policy for the twenty-first century. Baltimore: John Hopkins University Press; 2007.

9. McLellan AT, Carise D, Kleber HD. Can the national addiction treatment infrastructure support the public's demand for quality care? Journal of Substance Abuse Treatment. 2003; 25:117–21. [PubMed: 14680015]
10. Substance use and mental health services administration (SAMHSA) Ooas. Results from the 2008 national survey on drug use and health: national findings (NSDUH Series H-34, DHHS Publication No. SMA 08-4343). Rockville, MD: 2009.
11. Kiluk BD, Sugarman DE, Nich C, et al. A methodological analysis of randomized clinical trials of computer assisted therapies for psychiatric disorders: Toward improved standards for an emerging field. American Journal of Psychiatry. 2011; 168(8):790–99. [PubMed: 21536689]
12. Higgins ST, Budney AJ, Bickel WK, et al. Incentives improve outcome in outpatient behavioral treatment of cocaine dependence. Arch Gen Psychiatry. 1994; 51:568–76. [PubMed: 8031230]
13. Hunt GM, Azrinm NH. A community-reinforcement approach to alcoholism. Behavior Research and Therapy. 1973; 11:91–104.
14. Abbott PJ, Weller SB, Delaney HD, et al. Community reinforcement approach in the treatment of opiate addicts. American Journal of Drug and Alcohol Abuse. 1998; 24:17–30. [PubMed: 9513627]
15. Budney, RK.; Higgins, S. A community reinforcement plus vouchers approach: treating cocaine addiction. Rockville, MD: NIDA; 1998.
16. Gross A, Marsch LA, Badger GJ, et al. A comparison between low magnitude voucher and buprenorphine medication contingencies in promoting abstinence from opioids and cocaine. Experimental and Clinical Psychopharmacology. 2006; 14:148–56. [PubMed: 16756418]
17. Dennis MD, Godley SH, Diamond G, et al. The cannabis youth treatment study: main findings from two randomized trials. Journal of Substance Abuse Treatment. 2004; 27:197–213. [PubMed: 15501373]
18. Godley, SH.; Meyers, RJ.; Smith, JE., et al. The adolescent community reinforcement approach (A-CRA). Cannabis Youth Treatment (CYT) Series. Vol. 4. Rockville, MD: Center for Substance Abuse Treatment, Substance Abuse and Mental Health Services Administration; 2001.
19. Bickel WK, Marsch LA, Buchhalter AR, et al. Computerized behavior therapy for opioid-dependent outpatients: a randomized controlled trial. Exp Clin Psychopharmacol. 2008 Apr; 16(2): 132–43. [PubMed: 18489017]
20. Marsch, LA. Computer-delivered psychosocial treatment for substance use disorders. Presentation in symposium on Neurobehavioral and Technological Mechanisms to Improve the Efficacy and Effectiveness of Substance Abuse Treatment. In: Aklin, Will M.; Onken, Lisa, editors. American Psychological Association Annual Meeting; 2011; Washington, D.C.
21. Rohsenow DJ, Monti PM, Martin RA, et al. Brief coping skills treatment for cocaine abuse: 12 month substance abuse outcomes. Journal of Consulting and Clinical Psychology. 2000; 68:515–20. [PubMed: 10883569]
22. Miller WR, Wilbourne PL. Mesa Grande: a methodological analysis of clinical trials of treatments for alcohol use disorders. Addiction. 2002; 97:265–77. [PubMed: 11964100]
23. Kaminer, Y.; Slesnick, N. Evidence-based cognitive-behavioral and family therapies for adolescent alcohol and other substance use disorders. In: Galanter, M., editor. Recent developments in alcoholism, Vol XVII: Research on alcohol problems in adolescents and young adults. New York: Springer; 2005.
24. Barlow DH. Cognitive behavioral therapy for panic disorder: current status. Journal of Clinical Psychiatry. 1997; 58:32–6. [PubMed: 9078992]
25. Carroll KM, Nich C, Ball SA, et al. One-year follow-up of disulfarim and psychotherapy for cocaine-alcohol users: sustained effects of treatment. Addiction. 2000; 95:1335–49. [PubMed: 11048353]
26. Hall SM, Humfleet GL, Munoz RF, et al. Extended treatment of older cigarette smokers. Addiction. 2009; 104(6):1043–52. [PubMed: 19392908]
27. Carroll KM, Ball SA, Martino S, et al. Computer-assisted delivery of cognitive-behavioral therapy for addiction: a randomized trial of CBT4CBT. Am J Psychiatry. 2008; 165(7):881–8. [PubMed: 18450927]

28. Olmstead TA, Ostrow CD, Carroll KM. Cost-effectiveness of computer-assisted training in cognitive-behavioral therapy as an adjunct to standard care for addiction. Drug Alcohol Depend. 2010; 110(3):200–7. [PubMed: 20392575]
29. Kiluk BD, Nich C, Babuscio T, et al. Quality versus quantity: acquisition of coping skills following computerized cognitive-behavioral therapy for substance use disorders. Addiction. 2010; 105(12):2120–7. [PubMed: 20854334]
30. Miller, WR.; Rollnick, S. Motivational interviewing: Preparing people for change. New York: Guilford Press; 2002.
31. Smedslund G, Berg RC, Hammerstrøm KT, et al. Motivational interviewing for substance abuse. Cochrane Database Syst Rev. 2011; (5):CD008063. [PubMed: 21563163]
32. Stephens RS, Roffman RA, Curtin L. Comparison of extended versus brief treatments for marijuana use. J Consult Clin Psychol. 2000; 68:898–908. [PubMed: 11068976]
33. Ondersma SJ, Chase SK, Svikis DS, et al. Computer-based brief motivational intervention for perinatal drug use. Journal of Substance Abuse Treatment. 2005; 28:305–12. [PubMed: 15925264]
34. Ondersma SJ, Svikis DS, Schuster CR. Computer-based brief intervention: A randomized trial with postpartum women. American Journal of Prevention Medicine. 2007; 32:231–8.
35. Ondersma SJ, Svikis DS, Lam PK, et al. A Randomized Trial of Computer-Delivered Brief Intervention and Low-Intensity Contingency Management for Smoking During Pregnancy. Nicotine Tob Res. 2011
36. Hester RK, Delaney HD, Campbell W. The college drinker's check-up: Outcomes of two randomized clinical trials of a computer-delivered intervention. Psychol Addict Behav. 2011 Aug 8. [Epub ahead of print].
37. Hester RK, Delaney HD. Behavioral Self-Control Program for Windows: results of a controlled clinical trial. J Consult Clin Psychol. 1997; 65(4):686–93. [PubMed: 9256570]
38. Hester RK, Squires DD, Delaney HD. The Drinker's Check-up: 12-month outcomes of a controlled clinical trial of a stand-alone software program for problem drinkers. J Subst Abuse Treat. 2005 Mar; 28(2):159–69. [PubMed: 15780546]
39. Pemberton MR, Williams J, Herman-Stahl M, et al. Evaluation of two web-based alcohol interventions in the U.S. military. J Stud Alcohol Drugs. 2011; 72(3):480–9. [PubMed: 21513685]
40. Kidorf, M.; Stitzer, ML. Contingent access to clinic priveleges reduces drug abuse in methadone maintenance patients. In: Higgins, ST.; Silverman, K., editors. Motivating behavior change among illicit-drug abusers: contemporary research on contingency management interventions. Washington, D.C: American Psychological Association Books; 1999. p. 221-41.
41. Stitzer ML, Bigelow GE. Contingent reinforcement for reduced carbon monoxide levels in cigarette smokers. Addict Behav. 1982; 7(4):403–12. [PubMed: 7183194]
42. Robles, E.; Silverman, K.; Stitzer, ML. Contingency management therapise. In: Strain, EC.; Stitzer, ML., editors. Methadone treatment for opioid dependence. Baltimore: Johns Hopkins University Press; 1999. p. 196-222.
43. Higgins ST, Budney AJ, Bickel WK, et al. Incentives improve outcome in outpatient behavioral treatment of cocaine dependence. Arch Gen Psychiatry. 1994; 51:568–76. [PubMed: 8031230]
44. Silverman K, Higgins ST, Brooner RK, et al. Sustained cocaine abstinence in methadone maintenance patients through voucher-based reinforcement therapy. Arch Gen Psychiatry. 1996; 53:409–15. [PubMed: 8624184]
45. Silverman K, Wong CJ, Higgins ST, et al. Increasing opiate abstinence through voucher-based reinforcement therapy. Drug and Alcohol Dependence. 1996; 41:157–65. [PubMed: 8809505]
46. Downey KK, Helmus TC, Schuster CR. Treatment of heroin-dependent poly-drug abusers with contingency management and buprenorphine maintenance. Experimental and Clinical Psychopharmacology. 2000; 8:176–84. [PubMed: 10843300]
47. Piotrowski NA, Tusel DJ, Sees KL, et al. Contingency contracting with monetary reinforcers for abstinence from multiple drugs in a methadone program. Experimental and Clinical Psychopharmacology. 1999; 7:399–411. [PubMed: 10609975]
48. Dallery J, Glenn IM, Raiff BR. An Internet-based abstinence reinforcement treatment for cigarette smoking. Drug Alcohol Depend. 2007; 86(2–3):230–8. Epub 2006 Aug 22. [PubMed: 16930854]

49. Reynolds B, Dallery J, Shroff P, et al. A web-based contingency management program with adolescent smokers. J Appl Behav Anal. 2008; 41(4):597–601. [PubMed: 19192862]
50. Rosen MI, Dieckhaus K, McMahon TJ, et al. Improved adherence with contingency management. AIDS Patient Care and STDs. 2007; 21:30–40. [PubMed: 17263651]
51. Sorenson JL, Haug NA, Delucchi KL, et al. Voucher reinforcement improves medication adherence in HIV-positive methadone patients: a randomized trial. Drug and Alcohol Depend. 2007; 88:54–63.
52. Dallery J, Glenn IM. Effects of an Internet-based voucher reinforcement program for smoking abstinence: a feasibility study. J Appl Behav Anal. 2005; 38(3):349–57. [PubMed: 16270844]
53. Dallery J, Glenn IM, Raiff BR. An Internet-based abstinence reinforcement treatment for cigarette smoking. Drug Alcohol Depend. 2007; 86(2–3):230–8. [PubMed: 16930854]
54. Dallery J, Raiff BR. Contingency management in the 21st Century: Technological innovations to promote smoking cessation. Substance Use and Misuse. 2011; 46:10–22. [PubMed: 21190402]
55. Dallery J, Meredith S, Glenn I. A deposit contract method to deliver abstinence reinforcement for cigarette smoking. Journal of Applied Behavior Analysis. 2008; 41:609–615. [PubMed: 19192864]
56. Silverman K, Wong CJ, Grabinski MJ, et al. A web-based therapeutic workplace for the treatment of drug addiction and chronic unemployment. Behav Modif. 2005; 29(2):417–63. [PubMed: 15657415]
57. Silverman K, Wong CJ, Needham M, et al. A randomized trial of employment-based reinforcement of cocaine abstinence in injection drug users. J Appl Behav Anal. 2007; 40(3):387–410. [PubMed: 17970256]
58. DeFulio A, Donlin WD, Wong CJ, et al. Employment-based abstinence reinforcement as a maintenance intervention for the treatment of cocaine dependence: a randomized controlled trial. Addiction. 2009; 104:1530–8. [PubMed: 19686522]
59. Brooner RK, King VL, Kidorf M, et al. Psychiatric and substance use comorbidity among treatment-seeking opioid abusers. Arch Gen Psychiatry. 1997; 54:71–80. [PubMed: 9006403]
60. McLellan AT, Arndt IO, Metzger DS, et al. The effects of psychosocial services in substance abuse treatment. Journal of the American Medical Association. 1993; 269:1953–9. [PubMed: 8385230]
61. Kay-Lambkin FJ, Baker AL, Lewin TJ, et al. Computer-based psychological treatment for comorbid depression and problematic alcohol and/or cannabis use: a randomized controlled trial of clinical efficacy. Addiction. 2009; 104(3):378–88. [PubMed: 19207345]
62. Kay-Lambkin FJ, Baker AL, Kelly B, et al. Clinician-assisted computerised versus therapist-delivered treatment for depressive and addictive disorders: a randomised controlled trial. Med J Aust. 2011; 195(3):S44–50. [PubMed: 21806518]
63. Gustafson DH, Shaw BR, Isham A, et al. Explicating an evidence-based, theoretically informed, mobile technology-based system to improve outcomes for people in recovery for alcohol dependence. Subst Use Misuse. 2011; 46(1):96–111. [PubMed: 21190410]
64. Bogart LM, Kral AH, Scott A, et al. Sexual risk among injection drug users recruited from syringe exchange programs in California. Sexually Transmitted Diseases. 2005; 32:27–34. [PubMed: 15614118]
65. Avants SK, Margolin A, Usubiaga MH, et al. Targeting HIV-related outcomes with intravenous drug users maintained on methadone: a randomized clinical trial of harm reduction group therapy. Journal of Substance Abuse Treatment. 2004; 26:67–78. [PubMed: 15050083]
66. Margolin A, Avants SK, Warburton LA, et al. A randomized clinical trial of a manual-guided risk reduction intervention for HIV-positive injection drug users. Health Psychology. 2003; 22:223–8. [PubMed: 12683743]
67. Auerbach JD, Kandathil SM. Overview of effective and promising interventions to prevent HIV infection. World Health Organization Technical Report Series. 2006; 938:43–78. [PubMed: 16921917]
68. Holtgrave DR. Strategies for preventing HIV transmission. Journal of the American Medical Association. 2009; 302:1530–31. [PubMed: 19826020]
69. Noar SM. Computer technology-based interventions in HIV prevention: state of the evidence and future directions for research. AIDS Care. 2011 May; 23(5):525–33. [PubMed: 21287420]

70. Marsch LA, Bickel WK. The efficacy of computer-based HIV/AIDS education for injection drug users. American Journal of Health Behavior. 2004; 28:316–27. [PubMed: 15228968]
71. Marsch, LA.; Grabinski, MJ.; Bickel, WK., et al. Computer-Assisted HIV Prevention for Youth with Substance Use Disorders. In: Marsch, LA., editor. Special Issue on Technology and Substance Use Disorders. Substance Use and Misuse. Vol. 46. 2011. p. 46-56.
72. Bechara A. Decision making, impulse control, and loss of willpower to resist drugs: A neurocognitive perspective. Nature Neuroscience. 2005; 8:1458–1463.
73. Bickel, WK.; Marsch, LA. A future for the prevention and treatment of drug abuse: Applications of computer-based interactive technology. In: Henningfield, JE.; Santora, PB.; Bickel, WK., editors. Addiction treatment: Science and policy for the twenty-first century. Baltimore: John Hopkins University Press; 2007.
74. Bickel WK, Christensen DR, Marsch LA. A review of computer-based interventions used in the assessment, treatment, and research of drug addiction. Subst Use Misuse. 2011; 46(1):4–9. [PubMed: 21190401]
75. Grohman K, Fals-Stewart W, Donnelly K. Improving treatment response of cognitively impaired veterans with neuropsychological rehabilitation. Brain Cogn. 2006; 60(2):203–4. [PubMed: 16646121]
76. Pedrero-Perez EJ, Rojo-Mota G, Ruiz-Sanchez de Leon JM, et al. Cognitive remediation in addictions treatment. Rev Neurol. 2011 Feb 1; 52(3):163–72. [PubMed: 21287493]
77. Des Jarlais DC, Paone D, Miliken J, et al. Audio-computer interviewing to measure HIV risk behaviour among injecting drug users: a quasi-randomised tiral. The Lancet. 1999; 353:1657–61.
78. ONDCP. [Accessed 2010, 2010.] 2010 national drug control strategy. http://www.whitehousedrugpolicy.gov/
79. Jones, S.; Fox, S. Generations online 2009. Pew Internet & American Life Project; 2009. http://www.pewinternet.org/Reports/2009/Generations-Online-in-2009.aspx
80. Lenhart, A. Teensand mobile phones over the past five years: Pew internet looks back. Pew Internet & American Life Project; 2009. http://www.pewinternet.org/Reports/2009/14--Teens-and-Mobile-Phones-Data-Memo.aspx?r=1
81. Lenhart, A. Adults and social network websites. Pew Internet & American Life Project; Washington, D.C: 2009. http://www.pewinternet.org/Reports/2009/Adults-and-Social-%09Network-
82. Reuters. [Accessed 2009 February 27] Cell phone demand to stay despite downturn: UN. 2009. http://www.reuters.com/article/technology/News/idUSTRE51F1R420090216
83. Lenhart, A. [Accessed November 10, 2009.] The democratization of online social networks. http://pewinternet.org/Presentations/2009/41--The-Democratization-of-Online-Social-Networks.aspx
84. Horrigan, J. Wireless internet use. Pew Internet & American Life Project; 2009. http://pewinternet.org/Reports/2009/12-Wireless-Internet-Use.aspx
85. Gibbons, MC. eHealth solutions for healthcare disparities. New York: Springer Science + Business Media, LLC; 2007.
86. Boyer EW, Smelson D, Fletcher R, et al. Wireless technologies, ubiquitous computing and mobile health: application to drug abuse treatment and compliance with HIV therapies. Journal of Medical Toxicology. 2010; 6:212–6. [PubMed: 20623215]
87. Favela J, Tenton M, Gonzalez VM. Ecological validity and pervasiveness in the evaluation of ubiquitous computing technologies for health care. International Journal of Human-Computer Interaction. 2010; 26:414–44.
88. Orwat C, Graefe A, Faulwasser T. Towards pervasive computing in health care - a literature review. BMC Medical Informatics and Decision Making. 2008; 8(1–18)
89. Weiser, M. The computer for the 21st century. Scientific American; 1991 Sep. p. 94-104.
90. Rodriguez MD, Favela J, Preciado A, Vizcaino A. Agent-based ambient intelligence for healthcare. AI Communications. 2005; 18:201–16.
91. Boyer EW, Smelson D, Fletcher R, et al. Wireless technologies, ubiquitous computing and mobile health: application to drug abuse treatment and compliance with HIV therapies. Journal of Medical Toxicology. 2010; 6:212–6. [PubMed: 20623215]

92. Johnson K, Isham A, Shah DV, et al. Potential roles for new communication technologies in treatment of addiction. Curr Psychiatry Rep. 2011; 13(5):390–7. [PubMed: 21739171]

93. Collins LM, Murphy SA, Strecher V. The multiphase optimization strategy (MOST) and the sequential multiple assignment randomized trial (SMART): new methods for more potent eHealth interventions. American Journal of Preventive Medicine. 2007; 32(5 Suppl):S112–S8. [PubMed: 17466815]

94. Riley WT, Rivera DE, Atienza AA, Nilsen W, Allison SM, Mermelstein R. Health behavior models in the age of mobile interventions: are our theories up to the task? Behav Med Pract Policy Res. 2011 Feb 24; 1(1):53–71.

Brief Summary of Important Points

- Although there is strong empirical support for many psychosocial interventions targeting SUDs and related issues, they are rarely provided to those in need.
- Technology-based delivery platforms offer significant promise to increase the reach of evidence-based psychosocial interventions.
- There is a rapidly expanding research effort to translate evidence-based psychosocial interventions into technology-based platforms (e.g., web, computer, mobile phone).
- Many technology-based delivery platforms can provide ubiquitous, on-demand access to therapeutic support, and delivery evidence-based treatments with high fidelity.
- Despite the promise of technology, more scientifically rigorous work is necessary to establish efficacy and effectiveness in diverse settings, tailor treatment based on the needs of the user, and isolate mechanisms of behavior change produced by technology-based interventions.