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LEVERAGING TECHNOLOGY TO ENHANCE ADDICTION TREATMENT AND RECOVERY

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Abstract

Technology such as the Internet and mobile phones offers considerable promise for affecting the assessment, prevention, and treatment of and recovery from substance use disorders. Technology may enable entirely new models of behavioral health care within and outside of formal systems of care. This article reviews the promise of technology-based therapeutic tools for affecting the quality and reach of addiction treatment and recovery support systems, as well as the empirical support to date for this approach. Potential models for implementing technology-based interventions targeting substance use disorders are described. Opportunities to optimize the effectiveness and impact of technology-based interventions targeting addiction and recovery, along with outstanding research needs, are discussed.

Keywords

Technology; mobile health; computer; substance abuse treatment; recovery

Technologies such as the Internet and mobile phones offer considerable promise for affecting the assessment, prevention, and treatment of and recovery from substance use disorders.¹ Technology-based assessments (e.g., computerized assessments) of substance use may provide opportunities for increasing the standardization of assessment procedures and increasing the accuracy of self-reports of risk behavior, such as HIV-risk behavior. They may also enable assessment of substance use and related risk behavior in a broader array of settings that are beyond the scope of specialty addiction treatment settings, where resources and expertise in the assessment of substance use may be limited (e.g., general health care settings, community-based organizations). Importantly, technology-based assessments may allow for data about individual's substance use and triggers for use to be obtained from individuals in real-time (e.g., via mobile devices) outside of the confines of care settings where data collection procedures are traditionally limited by retrospective recall.

Technology-based interventions may include computer-assisted behavior therapies, prevention interventions (e.g., drug-abuse prevention, HIV-prevention programs), and recovery support programs.² These therapeutic tools offer considerable opportunities to enhance the reach of evidence-based interventions, particularly when they are centrally

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deployed online and made available to large numbers of individuals concurrently. They can be designed to ensure the fidelity of intervention delivery and enable anonymity, which may be particularly important to some individuals when addressing sensitive topics such as substance use and other risk behavior. In addition, these programs may also be tremendously cost-effective. Although the initial development of these programs can be costly, the cost of hosting and maintaining access to them thereafter is generally limited to costs associated with bandwidth needs for deployment and limited technical support. They can transcend geographic boundaries and allow for on-demand access to therapeutic support outside of formal care settings anytime and anywhere. Furthermore, technology-based therapeutic tools may also facilitate linkages to services in one's community.

Access to the Internet is rapidly increasing in the United States. Seventy-nine percent of Americans report regular use of the Internet, with access increasing in both rural and urban settings,⁵ as well as among low-income individuals with substance use disorders.⁶ In addition, approximately 83% of Americans subscribe to mobile phone services.⁷ Thus, the potential reach of innovative technological interventions offered on these platforms is enormous.

EMPIRICAL SUPPORT FOR TECHNOLOGY-BASED INTERVENTIONS TARGETING ADDICTION AND RECOVERY

A growing line of research studies has demonstrated that, if technology-based interventions targeting addiction and recovery are developed in a manner that embraces evidence-based behavioral principles as well as evidence-based multimedia learning principles, they can greatly affect substance use and related behavioral health outcomes.⁴

An example of one such program targeting addiction is the therapeutic education system, a Web-based psychosocial skills training intervention for individuals with substance use disorders. The therapeutic education system is built on the validated community reinforcement approach to behavior change. It has 65 interactive multimedia modules, starting with basic cognitive behavioral skills (e.g., refusal skills for risk behavior, managing harmful thoughts). Other modules teach skills to improve psychosocial functions (e.g., family and social relations, managing negative moods). The therapeutic education system is self-directed, includes functionality to build individualized treatment plans, assesses a patient's understanding of material, and adjusts the pace and level of repetition of material to promote skills mastery. Its interactive videos help individuals learn specific behaviors (e.g., progressive muscle relaxation). It also includes an optional system for delivering and tracking earnings of incentives for targeted behavior (e.g., participation in therapy sessions, drug-negative urine samples) in the context of a contingency management and motivational incentives positive reinforcement paradigm. Clinicians can view summaries of patients' therapeutic education system progress on their computers and can integrate the therapeutic education system usage data into counseling sessions if they choose.

The therapeutic education system has been evaluated in several randomized, controlled trials. The first randomized, controlled trial found that the therapeutic education system produced drug abstinence rates equivalent to comparable therapy delivered exclusively by highly trained clinicians and significantly greater abstinence rates than standard treatment.⁸ A separate trial demonstrated that when the therapeutic education system replaced a portion of standard addiction treatment (i.e., reducing face-to-face contact), abstinence rates were significantly greater than those produced by standard treatment alone.⁹ An additional randomized trial demonstrated that the HIV and infectious disease prevention modules within the therapeutic education system increased accurate prevention knowledge and was perceived as significantly more useful than traditional clinician-delivered care alone.¹⁰ The

therapeutic education system is being evaluated in several additional ongoing trials, including a multi-site study in outpatient substance abuse treatment programs on the Clinical Trials Network platform of the National Institute on Drug Abuse,¹¹ as well as a multi-site study evaluating the therapeutic education system with prisoners with substance use disorders.¹² Furthermore, early stage research evaluating a prototype of a mobile phone-based psychosocial support tool has produced exceptionally promising results in enhancing substance abuse treatment outcomes when provided as an adjunct to therapeutic education system.⁹

Additional addiction-focused computerized behavioral therapy interventions have shown considerable promise, including those in areas of cognitive behavioral therapy for cocaine¹³ and alcohol use disorders,^{14,15} motivational interviewing/motivational enhancement therapy for pregnant and postpartum women involved in substance use,^{16,17} and behavioral therapy for co-occurring substance use and depression.^{18,19}

An example of a promising technology-based recovery support tool is Addiction CHESS, or ACHESS, a Smartphone-based recovery support system²⁰ that is part of a larger suite of technology-based health systems known as CHESS. This tool is built on evidence-based principles of recovery support: long duration, assertive outreach, monitoring, prompts, action planning, peer and family support, and case management. Recovery support can improve health and reduce health-care use but is rarely used in addiction treatment due to limited resources for this type of care. Among ACHESS' features focused on personalized monitoring and support to individuals in recovery are a global positioning system for letting individuals know when they are near environments that are historically high-risk areas for them, functionality to monitor one's behavior and risk factors, personal stories of recovery experiences, and links to recovery support groups. Four-month tests with 192 alcohol-dependent participants found that ACHESS reduced heavy drinking days by 46% versus a control group. Results from ongoing clinical research with ACHESS suggest that it may be a valuable relapse prevention aid.

Flexible Models of Deployment

Technology-based therapeutic tools may be used in accordance with numerous flexible models and may enable entirely new models of delivering behavioral health care. They may be used in collaboration with more traditional models of intervention delivery (e.g., offered as an adjunct to substance abuse treatment). In this clinician-extender model, clinicians have the opportunity to extend their reach by offering these additional resources to their clients to support them outside of their direct interchange with their clinician.¹ In this framework, clinicians may offer these tools as a supplement to the work they do with their clients, including pharmacological treatments or combined behavioral and pharmacological treatments. Alternatively, they may replace a portion of their typical interaction with clients with a technology-based intervention, which may allow a treatment program to treat more clients with the same number of clinicians or free-up clinicians to have more time to manage client crises or spend more time with those with the greatest need for more intensive care. These therapeutic tools may also be offered as stand-alone interventions, which may be particularly relevant in rural or other settings where access to care may be limited or for individuals who do not wish to engage in traditional models of care. Because the majority of individuals with substance use disorders are not in substance abuse treatment,²¹ technology-based interventions offer tremendous opportunities to reach an unreached audience, and thus offer a considerable public health effect. Importantly, such tools offer considerable promise for ongoing recovery support (including opportunities for offering personalized recovery monitoring and support for a given individual or linkages to virtual recovery support communities). Importantly, technology-based therapeutic tools have the potential to enable

individuals (and optionally an extended support network) to play leading roles in their own care management.

Technology-based therapeutic tools targeting substance use and behavioral health may become increasingly important because under U.S. healthcare reform initiatives, mental and physical health care will be better integrated into patient medical homes (such as Federally Qualified Health Centers).²² In this shifting paradigm of treatment delivery, clinicians in these primary care settings will be asked to markedly increase behavioral health care offered in their care setting but may have limited time or specialty training in screening for or treating substance use disorders and other behavioral health issues. Thus, technology-based assessments and interventions may be exceptionally useful in this evolving health care context.

Opportunities to Optimize the Effectiveness and Impact of Technology-Based Interventions Targeting Addiction and Recovery

Although research to date on the application of technology to substance use disorders is promising, several exciting opportunities exist that promise to increase the quality and impact of this work. Although leveraging technology to target substance use is important, substance use behavior typically does not exist in a vacuum but rather often clusters with other co-occurring issues, including mental health issues, risk behaviors that may place one at risk for HIV and other infectious diseases, and challenges in medication adherence. Technology offers the opportunity to target numerous issues concurrently and to do so in a manner that offers an arguably unprecedented level of tailoring to the profile of needs of a given individual. Indeed, a technology-based system could be structured to conduct a comprehensive assessment of an individual's health behavior and then offer access to system components grounded in science-based approaches to promote health behavior in a model that is optimally responsive to each patient's needs. Such a tool could offer a comprehensive and coordinated approach to the constellation of issues a given individual may be experiencing.

A related opportunity is to further realize the potential of technology for real-time monitoring of a given individual's trajectory and then provide ongoing tailoring of intervention content that is responsive to that trajectory. Indeed, as individuals progress or fail to progress in their recovery, a technology-based system could modify the nature of the content and tools provided to the individual in a manner that is designed to improve outcomes. Ongoing monitoring could be achieved via self-report data (e.g., about substance use, stress levels, triggers, craving) obtained from individuals (and their significant others or support network) by the system on an ongoing basis. Monitoring may also occur via more unobtrusive techniques, such as via Smartphone sensing and other sensor approaches for monitoring health behavior. Indeed, exciting developments are occurring in the sensor research community, with promising results of studies seeking to use sensors (including those that exist on mobile phones) to reliably infer an individual's stress, activity, or sociability levels, as well as affect other physiological states.^{23–25} Relatedly, promising work is developing in the application of machine learning approaches to capture such data in real-time (either via sensors, individual input, or both) and then make inferences about patterns in the data to learn and then adapt feedback to the individual in a manner that is responsive to the data input. Thus, one could envision a technology-based system that can learn about a given individual's pattern of risk factors (those that may place them at risk for substance use or other risk behavior), as well as any changing patterns over time, and provide tailored feedback or intervention content to be optimally responsive to a given individual's profile over time. Such a model may also enable an entirely new model for interfacing with clinicians by, for example, offering much richer, detailed data about clients to their clinicians, which may affect the nature of the clinical care that is delivered.

Research Needs

Researcher and clinical communities are demonstrating increasing excitement about the promise of technology in health care delivery, including interventions targeting addiction and recovery. As this field moves forward, several important research considerations and empirical questions remain. Among these is the importance of ensuring that a scientific process and clinical considerations drive the use of technology in assessment and intervention efforts, with great caution to avoid a process where the existence of exciting and powerful new technologies drive their clinical application. To help ensure a careful, scientific process in the development, evaluation, and dissemination of technology-based therapeutic tools, expanded methodological and conceptual frameworks are needed to better guide this line of scientific inquiry. A related opportunity exists to understand the extent to which these frameworks may need to differ from those that have guided other areas of research (such as the development and evaluation of traditionally delivered psychosocial interventions). In addition, a better understanding of the mechanisms of behavior change and health behavior promotion as a result of technology-based interventions relative to traditionally delivered interventions is needed. Given the ubiquitous access to therapeutic support offered by technology-based therapeutic tools and their ability to offer unprecedented levels of tailoring, the nature and rate by which these tools affect behavior may differ from those affected by traditional intervention models. Such data may also help better identify the active ingredients of such tools.

Additional and underexplored research questions of considerable significance to this work are those related to important privacy and security considerations, as well as legal, regulatory, and ethical considerations in this work. Although many considerations with technology-based interventions may not substantively or qualitatively differ from similar considerations with traditionally delivered approaches, several issues may be unique to a process of collecting data and delivering interventions via technologies. Systematic guidelines to inform developers, researchers, clinicians, and clients about such issues are needed.

A significant opportunity and need exists in the research community for better understanding of how to optimally integrate empirically supported technology-based assessment and intervention programs into systems of care. Indeed, the community friendliness of a technology-based tool is an important consideration at the outset of an effort to develop such a program. Models for promoting dissemination, implementation, and sustainability of such technology-based systems into care settings need to consider all relevant stakeholders within the system (e.g., client, clinicians, program directors, organization, payers). In addition, data on cost-effectiveness and sustainable reimbursement models are critical. Such data will be critical to promoting broad reach of evidence-based, technology-delivered interventions.

Overall, a substantial opportunity exists for leveraging technology in the assessment and delivery of interventions targeting substance use disorders and behavioral health. Data from this line of research to date strongly underscore the potential for this approach to markedly affect models of care and revolutionize existing models of health care delivery.

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