

ORIGINAL ARTICLE

Explicating an Evidence-Based, Theoretically Informed, Mobile Technology-Based System to Improve Outcomes for People in Recovery for Alcohol Dependence

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Post-treatment relapse to uncontrolled alcohol use is common. Currently available communication technology can use existing models for relapse prevention to cost-effectively improve long-term relapse prevention. This paper describes: (1) research-based elements of alcohol consumption-related relapse prevention and how they can be encompassed in self-determination theory (SDT) and Marlatt's cognitive behavioral relapse prevention model, (2) how technology could help address the needs of people seeking recovery, (3) a technology-based prototype, organized around sexual transmitted disease and Marlatt's model, and (4) how we are testing a system based on the ideas in this article and related ethical and operational considerations.

Keywords technology, relapse prevention, alcohol dependence, mobile phone, cell phone, triggers, recovery

INTRODUCTION

An estimated 17.6 million persons (7.1% of the population aged 12 years or older) are classified with alcohol use disorders (Grant & Dawson, 2006; SAMHSA, 2008). Of these, 3.9 million persons received some kind of treatment for their use and misuse of alcohol or illicit drugs in 2005. Social costs of alcohol abuse and dependence in the United States are estimated to be approximately \$184.6 billion per year (Harwood, 2000).

Despite numerous advances in the treatment of alcoholism, relapse to heavy or uncontrolled use remains common—sometimes as high as 80% (Bradizza, Stasiewicz, & Paas, 2006; Brownell, Marlatt, Lichtenstein, & Wilson, 1986; Dennis, Scott, & Funk, 2003; Donovan, 1996; Lowman, Allen, & Stout, 1996; McKay & Weiss, 2001; McLellan, 2002; Mueller, Petitjean, Boening, & Wiesbeck, 2007; Witkiewitz & Marlatt, 2004). Relapse reduces quality of life and strains family relationships, while abstinence improves emotional and family/social functioning (Ettner, 2006). Furthermore, abuse¹ of alcohol and other drugs is associated with serious public health and safety problems (McLellan, Lewis, O'Brien, & Kleber, 2000), exacts great societal costs including a higher crime rate (Ettner, 2006), elevates healthcare costs (Ettner, 2006), and reduces productivity (Hoffman, DeHart & Fulerson, 1993; Slaymaker & Owen, 2006).

Although most experts currently consider alcoholism to be a chronic disease, providers do not typically offer ongoing support for relapse prevention after patients complete their treatment. While aftercare appointments may be set up, ongoing monitoring or “check-ups” to ensure compliance with treatment recommendations, which are common with other chronic disorders, are rare in addiction (McLellan et al., 2000; White, Boyle, & Loveland, 2002). Most research supports the effectiveness of continuing care for alcohol and drug users (McKay, 2005), finding that prolonged participation is associated with better outcomes (McLellan, McKay, Forman, Cacciola, &

This research is being supported by a grant from the National Institute of Alcohol Abuse and Alcoholism.

¹The journal's style utilizes the category *substance abuse* as a diagnostic category. Substances are used or misused; living organisms are and can be abused. Editor's note.

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Kemp, 2005; Simpson, 2004). Unfortunately, because the alcohol treatment infrastructure² is financially overburdened, labor-intensive, and unstable, continuing care is not widely available (McLellan, Carise, & Kleber, 2003).

On the basis of the above research, it is clear that new, more cost-effective strategies are needed to improve access to continuing care and help achieve its promise. Using past research as a guide, we argue in this article that currently available mobile communication technologies can be used to cost effectively complement and extend existing models for relapse prevention services to improve long-term outcomes for individuals struggling with alcohol-dependence disorders. First, we summarize what previous research suggests are essential elements of ongoing relapse prevention programs and how these constructs can be encompassed within the frameworks of the self-determination theory (SDT) and Marlatt's cognitive behavioral relapse prevention model and how they are relevant to the nature of alcoholism. Second, we describe how technology could be used to address the needs of people attempting to achieve a long-term recovery and complement the way services are currently offered. Third, we explicate how our proposed technology-based prototype services, organized around constructs specified in the SDT, align with stages specified by Marlatt's cognitive behavioral relapse prevention model. Finally, we describe steps that are currently being undertaken to test the ideas put forth in this article and discuss both ethical and operational considerations that are being addressed in launching this initiative.

ELEMENTS OF SUCCESSFUL RELAPSE PREVENTION PROGRAMS

It should be noted that some people have spontaneous recovery and avoid relapse on their own (cf. Klingemann & Sobell 2001; Shorkey, 2004).³ However, for the many who do not, there is abundant evidence that inadequate coping strategies, a lack of social support, and flagging motivation, among other factors, are associated with heightened likelihood of relapse. We also acknowledge that these are only some of the factors associated with relapse. Our model is focused more on cognitive, affective, social, and

environmental influences on relapse and is not a model of neurobiological, genetic, or other bases of addiction and relapse.

In this section, we synthesize information on the nature of alcoholism, the factors that contribute to a successful recovery, and present a theory of behavior change and motivation—self-determination theory—that serves as our organizing framework for understanding how these constructs work together to influence treatment outcomes.

Coping and Competence

Research has shown that execution of coping behaviors is associated with decreased likelihood of relapse to alcohol use (Anderson, Ramo, & Brown, 2006; Maisto, Zywiak, & Connors, 2006; Shiffman, 1984, 1986). An increased tendency to engage in effective, adaptive coping is associated with: (1) low levels of an avoidant coping style, with avoidant coping being characterized by distraction or escape rather than active, problem-focused coping (see Chung et al., 2001, as well as Moos & Moos, 2006); and (2) high levels of self-competence or self-efficacy appraisals (Gwaltney, Shiffman, Balabanis, & Paty, 2005; Litt, Kaden, Kabela-Cormier, & Petry, 2008; Witkiewitz & Marlatt, 2004). The importance of coping execution is shown by evidence that routine self-monitoring of triggers of alcohol use (Helzer, Badger, Rose, Mongeon, & Searles, 2002; Stout, Rubin, Zwick, Zywiak, & Bellino, 1999) as well as reactive and proactive coping execution (e.g., urge coping or the avoidance of people, places, and things associated with prior alcohol-using experiences) leads to sustained abstinence and early detection of alcohol use, which permits re-engagement in treatment to forestall an escalation of use (Baker & Kirschenbaum, 1998; Carroll, 1996; Dennis et al., 2003; Godley, Godley, Dennis, Funk, & Passetti, 2002; Irvin, Bowers, Dunn & Wang, 1999; Miller, 1987; Stalcup, Christian, Stalcup, Brown, & Galloway, 2006). Additionally, prior research has highlighted the sorts of coping behaviors that are most beneficial, including the anticipation of high-risk contexts, plans to mitigate these risks, engagement in active behavioral or cognitive coping strategies when confronted by acute crises such as urges and negative affect. It also highlights what is not beneficial, including a tendency to delay or avoid active coping (an avoidant coping style). Unfortunately, many individuals will not engage in problem solving/coping without being prompted to do so (Davis & Glaros, 1986; Larimer, Palmer, & Marlatt, 1999).

Individuals manifesting an alcohol use disorder may fail to engage in adaptive monitoring and coping for multiple reasons. For instance, over time, routine daily activities become *automatic*; i.e., they tend to be elicited and executed without significant awareness (e.g., Tiffany, 1990). Automatic processing may be contrasted with controlled or effortful processing, which is characterized by awareness and controllability. Without awareness, there is little opportunity for conscious, deliberative planning to influence people to change their ways. In other words, over time, the recovering substance user may fall in with

²Treatment can be briefly and usefully defined as a planned, goal directed, temporally structured change process, of necessary quality, appropriateness, and conditions (endogenous and exogenous), which is *bounded* (culture, place, time, etc.) and can be categorized into professional-based, tradition-based, mutual-help based (AA, NA, etc.) and self-help ("natural recovery") models. There are no unique models or techniques used with substance users—of whatever types and heterogeneities—which are also not used with non-substance users. In the West, with the relatively new ideology of "harm reduction" and the even newer quality of life (QOL) treatment-driven model, there are now a new set of goals, in addition to those derived from/associated with the older tradition of abstinence driven models. Treatment is implemented in a range of environments; ambulatory, within institutions which can include controlled environments. Editor's note.

³The reader is referred to the "natural recovery" literature, which documents the cessation of substance use and misuse without tradition-based, professionally based or mutual-help-based (AA, NA, OA, etc.) planned interventions. Editor's note.

old crowds and pick up old behaviors associated with alcohol use, without thinking about the potential risks or alternatives (Curtin, McCarthy, Piper, & Baker, 2006; McCarthy, Curtin, Piper, & Baker, 2009).

The substance user's execution of effective coping may also be thwarted by other factors. To the extent that the substance user fails to avoid temptation situations (e.g., places or behaviors associated with prior alcohol use), these situations will tend to elicit alcohol use-related behaviors via associative (learning) mechanisms. If the person is to avoid alcohol use, the possibility of alcohol use must enter his/her awareness so that it becomes a choice and not a "reflex." That is, attention and cognitive control processes/resources must interrupt the automatic sequence of alcohol self-administration behaviors, introducing it to conscious awareness, and then applying problem solving or coping processing so that other responses may be substituted for it (e.g., generate alternatives, justify a delay of gratification, and so on: Curtin et al., 2006; McCarthy et al., 2009; Tiffany, 1990). Functional or adaptive decisions might include future avoidance of the alcohol cues/temptation situation, engagement of a pleasant alternative behavior, or seeking positive social support that will enhance the motivation to maintain abstinence. There is, in fact, considerable evidence that coping response processing and execution predicts superior outcomes (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; Burgess et al., 2002; Shiffman, Paty, Gnys, Kassel, & Hickcox, 1996).

Alcoholics may also have cognitive control deficits relative to other individuals. That is, they do not interrupt automatic behaviors as well (are "impulsive" and less able to inhibit behaviors in response to provocative cues), and may have neuropsychological deficits that may interfere with adaptive problem solving (e.g., Courtney & Polich, 2009; Stout, Rock, Campbell, Busemeyer, & Finn, 2005; Woods et al., 2005). Cognitive control resources are capacity limited, but capacity may be especially limited for substance users (e.g., Nigg et al., 2004).

Given these features of motivation and information processing among individuals with alcohol use disorders, why might a mobile, technology-based system aid a person striving to attain or maintain abstinence? Such a system can be engineered to serve as an electronic prosthesis for the alcohol user's cognitive control deficits. For instance, the system can monitor the individual's activities and locations in order to detect risks that may be opaque to the individual. Moreover, simply by probing behavior and context, the system could heighten the individual's awareness of danger and recruit cognitive control resources. The system could also prompt planning to decrease the likelihood of future alcohol use. In addition, the system could enhance the individual's ability to cope with temptation to use once it enters awareness; it could suggest more or better coping responses than would occur to the person as she/he battles a strong motivation to use alcohol. Furthermore, the system may make a greater variety of coping responses available. For instance, the system may give the person ready access to counseling or advice

(feedback would, among other things, add the counselor's cognitive control resources to the substance users) or social support. It might also provide access to information processing supports such as decision aids that bolster the person's own decision-making abilities. Another such aid would be games that occupy mental workspace. This could be useful, as such games could displace urge processing (given capacity limitations noted earlier).

In summary, alcoholism involves the patient's struggle to exert cognitive control over behaviors that are not anticipated, and that challenge the person's cognitive control resources because of intrinsic capacity limitations, the absence of attractive alternative responses, and fundamental ambivalence regarding the relative values of immediate versus delayed outcomes. An effective technology-based support system could provide resources that address all of these needs.

Social Support

Research indicates that lack of actual and perceived positive social support or the existence of social pressure is associated with relapse vulnerability (Beattie & Longabaugh, 1999; Broome, Simpson, & Joe, 2002; Havassy, Hall, & Wasserman, 1991; McMahon, 2001; Zywiak, Westerberg, Connors, & Miasto, 2003). People in recovery who remain involved with self-help groups have superior abstinence outcomes (Dobkin, De, Paraherakis, & Gill, 2002; Finney, Moos, & Mewborn, 1980; Ouimette et al., 2001; Ouimette, Moos, & Finney, 2003; Schradle & Dougher, 1985). One way to prevent relapse is to help people early in recovery feel connected with others in alcohol-free recreational activities (Meyers, Smith, & Lash, 2003; Schottenfeld, Pantalon, Chawarski, & Pakes, 2000). Furthermore, research suggests that relapse can be reduced if people in recovery can reach case managers to help with service access, monitor for lapse cues, and provide social support for coping with challenging issues (Godley et al., 2002; McLellan et al., 1999; Rapp, Siegal, & Fisher, 1992).

Technology can be used in several ways to improve social support to prevent relapse. It can allow people in recovery to talk with and support one another through online support groups and activities. It can also provide a variety of ways to easily reach individuals such as clinicians or significant others (e.g., text messages, phone calls, and e-mails).

Autonomous Motivation

Clearly, there is substantial evidence that self-reported motivation is related to abstinence outcomes (Piasecki, Fiore, McCarthy, & Baker, 2002; Witkiewitz, van der Maas, Hufford, & Marlatt, 2007) and a reduced sense of intrinsic or autonomous motivation is associated with relapse (Curry, Wagner, & Grothaus, 1990; McBride et al., 1994; Miller & Rollnick, 1991; Williams, Gagne, Ryan, & Deci, 2002; Williams, Freedman, & Deci, 1998). Fortunately, research also shows that motivation, in general, and intrinsic motivation, in particular, can be increased through treatment. For example, mounting evidence shows that personalized or tailored information

and motivational interviewing approaches improve both motivation level and outcomes for people attempting to reduce problem drinking or other forms of alcohol use (Cunningham, Humphreys, Kypri, & van Mierlo, 2006; Hester & Delaney, 1997; Hester & Miller, 2006; Hester, Squires, & Delaney, 2005; Koski-Jannes, Cunningham, Tolonen, & Bothas, 2006).

Technology offers the potential to provide immediate multi-media (1) access to personal stories of the struggles and successes of others who have dealt with alcoholism, (2) access to decision aids that help a user think through key issues in their lives, (3) access to an inventory of practical tools that can ease the process of relapse prevention, and (4) that do so in a respectful style that does not alienate the user because it can give them options rather than telling them what to do.

Self-Determination Theory and Cognitive-Behavioral Relapse Prevention

The targeting of the three major dimensions or change mechanisms discussed above (coping competence, social support, and autonomous motivation) aligns with tenets of SDT. Indeed, SDT posits that satisfaction of three fundamental needs contributes to adaptive functioning; i.e., perceived competence, a feeling of relatedness (feeling connected to others), and autonomous motivation (feeling internally motivated and uncoerced in one's actions) (Ryan & Deci, 2006). SDT (Ryan & Deci, 2000) also makes the case that quality of life is largely a matter of the degree to which three basic psychological needs for autonomy, competence, and relatedness are met. Many studies have related satisfaction of these basic needs to well-being and quality of life (Ryan & Deci, 2000).

The three change mechanisms discussed above are also consistent with Marlatt's cognitive-behavioral relapse prevention model. Marlatt's relapse prevention model is widely accepted by addiction treatment opinion leaders (Maisto, Conners, & Zyiak, 1996; McKay, 1999; Stout, Longabaugh, & Rubin, 1996), especially when used to inform the treatment of alcoholism (Irvin et al., 1999), and is not mutually exclusive with the more general SDT. The cognitive behavioral relapse-prevention model suggests that both immediate determinants (high-risk situations, lack of coping response, decreased self-efficacy, and abstinence violation effects) and covert antecedents (lifestyle imbalances, urges, and cravings) can lead to relapse. The model includes interventions that address each of the dimensions that precede relapse, suggesting both specific (e.g., identifying high-risk situations and managing lapses) and global (e.g., balancing lifestyle, pursuing positive, and rewarding activities) strategies.

In the next section, we discuss our previous work in developing and evaluating technology-based information and support systems to help people cope with illness. Building on these experiences, we describe how a mobile, technology-based system, grounded in the change mechanisms and theoretical models of relapse described above, could be used to reduce the likelihood of relapse among people in recovery by (1) prompting coping behaviors,

(2) facilitating access to social support, and (3) encouraging autonomous motivation abstinence, across the covert antecedents and immediate determinates (lifestyle imbalance, desire for indulgence, etc.) suggested by Marlatt's model.

FEASIBILITY OF A MOBILE, TECHNOLOGY-BASED RELAPSE PREVENTION SYSTEM

On the basis of the above review of extant research, we propose that numerous evidence-based features could be integrated into a comprehensive technology-based solution to improve long-term recovery outcomes in a cost-effective manner. The team behind this initiative comprised of individuals working with the Network for Improvement of Addiction Treatment (NIATx), which delivers quality improvement interventions to nearly 1000 substance user treatment providers across the United States (see NIATx.net) and the developers of the Comprehensive Health Enhancement Support System (CHESS), a computer system designed to help people cope with various health concerns. Both NIATx and CHESS reside within one research center at the University of Wisconsin-Madison in the United States.

CHESS is an umbrella term for several computer based eHealth systems that our research team has developed and tested (<http://chess.wisc.edu>). CHESS programs provide information, adherence strategies, decision-making tools and support services in attractive, easy-to-use formats. Content has typically been presented at a sixth-grade reading level and focused on specific needs identified in studies of the target population. Compared with the unrestricted Internet access, the most important strength of CHESS may be its closed, guided universe of tailored information and support options in an integrated package with efficient navigation eliminating the need for complicated search and discovery. ACHES (Addiction CHESS), the focus of the research reported below, differs from previous CHESS programs in two important ways. (1) This project is designed to meet the needs of people with reading levels lower than sixth grade by providing audio and video access to material. (2) Instead of functioning on a desktop or laptop computer, it uses a smart phone to greatly expand its mobility.

For the last six years, our research center has been one of the four National Cancer Institute designated Centers of Excellence in Cancer Communications Research because of our work with CHESS. Historically, we have emphasized randomized trials to test the effectiveness of such systems on cancer patients (we have six ongoing at this time). We also have three such trials completed or underway for improving control of a chronic disease. Randomized clinical trials have repeatedly found that CHESS improves quality of life and produces behavior change for people facing various health issues. The empirical results are summarized below:

Needs Assessment

We have extensive experience conducting needs assessments as well as in developing and testing CHESS

systems to meet those needs (Boberg et al., 2003; Gustafson, Bosworth, Chewning, & Hawkins, 1987, 1993, 2001; Pingree et al., 1996; Shaw, McTavish, Hawkins, Gustafson, & Pingree, 2000). For example, to inform ACHES, we conducted a multi-site study to identify and prioritize needs of alcohol- and other drug-dependent patients, their families, counselors, child welfare and criminal justice personnel, and primary care physicians. We started with focus groups of 48 people that included needs identification and reaction to various technological support components for ACHES. A survey instrument was developed to assess the importance of and satisfaction with how well each need was currently being met in their lives. Fifteen treatment agencies participating with NIATx distributed the survey to people in recovery enrolled in intensive outpatient programs, their families, and related professional personnel. The top identified needs in priority order were to help patients: (1) understand what addiction really is; (2) know how to stop a relapse; (3) be prepared to function in society upon reentry into their normal, everyday lives following the more intensive therapy they receive early in recovery; (4) obtain truly individualized treatment; (5) find motivation to stay in treatment and take it seriously; (6) choose a treatment that is most likely to succeed; (7) improve ability to resist temptations; (8) know the things that make one vulnerable to relapse; and (9) know the warning signs of impending relapse. As described below, ACHES is designed to meet those needs.

BARN

To directly support people in need, our research on computer-based systems began with a grant in 1980 from the W.K. Kellogg Foundation to develop a personal computer-based system to support at-risk teenagers as they dealt with issues such as smoking, illicit drug use, and sex (Gustafson et al., 1987). We created a computer-based system called BARN (Body Awareness Research Network) offering some (but not all) of the features in CHES today. An evaluation demonstrated that while the system was widely accepted and used, the program was not successful in preventing risk-taking behavior (Bosworth, Gustafson, & Hawkins, 1994). However, BARN was able to help teenagers who had already engaged in such behaviors (e.g., getting sexually active teenagers to adopt more safe-sex behaviors). These experiences and the advent of more sophisticated computer systems (e.g., ability to offer discussion groups and access to the Web) led us to believe that we could help patients facing serious medical problems.

Impact on HIV-Infected People

Two hundred HIV-infected people were randomly assigned to either no intervention (control) or CHES on a desktop computer in their homes. Subjects were surveyed at pre-test and 2- and 5-month post-tests. The 100 experimental subjects used CHES over 16,000 times during the first nine weeks of the study. Demographic characteristics, HIV illness stage, and health status had little relation to CHES use. Five of the eight

quality-of-life measures (activity, reduced negative emotions, social support, cognition, and participation in healthcare) significantly improved in those having CHES access compared with those who did not. Average time spent with physicians dropped significantly for CHES users, as did average length of hospital stay.

Impact on Disadvantaged People

A National Institutes of Health (NIH) funded randomized controlled trial of 346 women under 60 years of age with breast cancer, one-third of these including underserved minorities, evaluated CHES impact over a 6-month period. Compared with controls, CHES patients participated more actively in their healthcare. They also perceived themselves to be more competent in handling information. Four of the six quality-of-life measures showed significant interactions as did measures of participation in healthcare. Disadvantaged women benefited from CHES more than white, privately insured women. In general, poor, minority CHES users moved to levels similar to (and statistically not different from) those of middle-class white women (Gustafson et al., 2001).

Feasibility of Reaching Underserved Populations

A population study was designed to overcome the digital divide by testing interventions to increase access to and use of CHES. Using several contact models (e.g., Medicaid patient lists, Cancer Information Service, Public Health Departments, and media), CHES was offered to two full populations of women recently diagnosed with breast cancer who were living at or below 250% of poverty and will be referred to as "underserved" (Gustafson et al., 2005). We found that given the opportunity to access a health system such as CHES, the underserved will use it, and 40% of eligible patients accepted CHES and used it as much if not more than their more advantaged counterparts. In addition, access to CHES correlated with improvement in quality of life and greater participation in their healthcare. However, we also found that 47% of the urban and 20% of the rural adult population were functionally illiterate. This led us to design the audio-based CHES alternative that is a key focus of ACHES.

CHES Effects on Asthma Control

An NIH grant funded a randomized trial of a personal computer (CHES) and nurse case manager to support parents of children (aged 4–12 years) with moderate-to-severe asthma. Parents were randomly assigned to 12 months of standard care control or computer-based CHES in their homes, coupled with an asthma nurse case manager. We recruited 305 subjects (50% Medicaid families) with less than a 15% dropout. The CHES group received tailored information based on bi-weekly "check ins" and links to CHES material created by their nurse case managers following phone contacts. There was no difference between control and experimental groups at baseline. However, CHES patients were practically (effect size >.40) and significantly better on all three follow-up tests of asthma control. We learned several

things to inform our work with alcoholics: (a) home-based personal computer means that CHESS is only available at home, potentially limiting its usefulness elsewhere, (b) case managers can make a significant difference if they intervene before the crisis begins, and (c) patients might manage their disease more effectively if they had just-in-time support. These experiences led us to believe that chronic disease control might be improved by a mobile smart phone system (M-CHESS) with easy-to-access, just-in-time information, tools, reminders, and tracking as well as support and advice from peers and case managers. Currently, this mobile tool is being evaluated under a grant from the National Institute of Nursing Research in a randomized clinical trial with inner city teenagers with moderate to severe asthma.

Smoking Cessation for Teens and Adults

Two NIH-funded randomized trials tested the effects of CHESS programs to help smokers quit. One project involving 140 teen smokers was conducted jointly with the Mayo clinic. It found that CHESS produced a significant reduction in the average number of days smoked compared with a control group (Patten et al., 2006). Another CHESS smoking cessation program developed in partnership with Wisconsin's Center for Tobacco Research and Intervention was aimed at helping adults quit. The number of times participants used CHESS per week was significantly related to abstinence both at end of treatment and at the 6-month follow-up, indicating that CHESS makes a difference for people who use it (Japuntich et al., 2006). However, subject interviews suggested that using a personal computer for information and support was inconvenient and not available when it was most needed. This experience also played a role in deciding to develop the mobile ACHES system.

CHESS Compared to the Internet

A National Library of Medicine (NLM) funded grant compared CHESS' use and impact to unguided access to the Internet among recently diagnosed breast cancer patients. We provided the same computers and amount of training to both study arms ($N = 257$). Internet users were linked to six high-quality breast cancer Web sites. We compared CHESS and Internet users on quality of life, social support, and health information competence at 2, 4, and 9 months (5 months after computers were removed). CHESS subjects logged on to the computer more than Internet subjects and accessed more health resources. The Internet group used non-health sites much more than health sites. Internet subjects experienced no better outcomes than controls at any of the three time points. CHESS subjects had greater social support at 2 and 4 months and higher scores on all outcomes at 9 months. CHESS subjects also scored higher than subjects assigned to an Internet-only condition. These results provided encouraging evidence (albeit from cancer patients and not alcoholics) that giving people who are dealing with alcoholism health challenges access to the Internet is unlikely

to have the same effect as the system we are developing (Gustafson et al., 2008).

Application of CHESS to Alcoholism

We are now in the second year of a National Institute on Alcohol Abuse and Alcoholism (NIAAA) funded grant to extend our work with CHESS to develop and test, through a currently ongoing randomized clinical trial, an integrated relapse-prevention system called "Alcohol-Comprehensive Health Enhancement Support System" (ACHES). The ACHES intervention is explicitly designed to address the three constructs described above (coping competence, social support, and autonomous motivation) and the primary hypothesis is that ACHES will reduce risky drinking days.

Addressing the range of functions described above to enhance post-treatment discharge recovery would be prohibitively costly, impractical, and labor-intensive using procedures currently available in the alcohol treatment field today. However, a technology-based system delivered via smart phones might overcome these barriers to implementation. Such a system could offer people in recovery support whenever and wherever it is needed, and have the potential to reduce costs and improve the effectiveness of existing alcohol treatment programs.

We argue in this article that addressing each of the above-mentioned constructs related to preventing relapse and extending continuing care in a cost-effective manner could be accomplished using wireless Internet-enabled mobile phone technology that is readily available today. ACHES would integrate these services to offer people in recovery a comprehensive, scientifically informed intervention that addresses principal relapse risks, and reduces the likelihood of relapse as well as the negative consequences associated with risky drinking behavior (Hester & Miller, 2006).

Preliminary studies on people using technology-based services for managing recovery from alcoholism are encouraging. First, many people facing substance use-related issues have an interest in self-help tools to evaluate their behaviors; computerized interventions have been identified as being attractive for this purpose (Cunningham, Wild, & Walsh, 1999). Additionally, research indicates that self-administered questionnaires about addictive behavior can be a feasible alternative to interviews conducted by addiction professionals. In fact, patients acknowledge more alcohol use and psychiatric symptoms through online questionnaires than through face-to-face interviews (Rosen, Henson, Finney, & Moos, 2000). Furthermore, previous research indicates that mobile technology (e.g., interactive voice response: IVR) can be an effective way to collect data from people diagnosed with substance use disorders (Simpson, Kivlahan, Bush, & McFall, 2005), which can then be used to trigger supports as needed to help people in recovery avoid a relapse. Indeed, compliance in these studies using mobile devices has been very high with people responding to over 93% of calls made (Searles, Helzer, Rose, & Badger, 2002). As excessive consumption of alcohol is associated

with marked deficits in cognitive functioning (Sullivan, Rosenbloom, & Pfefferbaum, 2000) including visual scanning needed for reading (Beatty, Hames, Blanco, Nixon, & Tivis, 1996), it is also believed that audiovisual capabilities will help some users of this system more easily access the information and support they need to stay abstinent and avoid risky drinking.

EXPLICATING A MOBILE, TECHNOLOGY-BASED RELAPSE PREVENTION SYSTEM

As referred to above, the design of the ACHESSE relapse prevention system is influenced by both SDT and Marlatt's relapse prevention model, which build upon and integrate a rich tradition of social sciences research related to behavior change (Bandura, 1977), social learning (Rhodes, Fishbein, & Reis, 1977), persuasive communication (Hovland, Janis, & Kelley, 1964), motivational interviewing (Miller & Rollnick, 1991), behavioral intent (Ajzen & Fishbein, 1977), and stages of change (Prochaska & DiClemente, 1983). SDT focuses on developing competence, relatedness, and autonomy. ACHESSE employs these concepts in the following ways to prevent relapse: (1) develop/maintain autonomous motivation to prevent relapse (autonomy supportiveness); (2) offer resources to cope with pressures to relapse, e.g., cravings, withdrawal symptoms, high risk situations (competence); and (3) provide access to social support to persevere (relatedness).

Not only is the ACHESSE prototype consistent with important theory and research evidence, but, as described above, it is also informed by input from individuals manifesting alcohol and other substance use disorders, their family members, and thought leaders from addiction treatment, health informatics, and other allied disciplines (Gustafson et al., 2005). A series of planning meetings identified patient, family, and provider needs as well as technology-based innovations that could address these needs.

The ACHESSE system is compatible with the view that addiction is a chronic, relapsing disorder.⁴ We anticipate that days of risky drinking should be reduced by interrupting the advancement of stages preceding relapse (Larimer et al., 1999), which will be mediated by social support, autonomous motivation, competence or coping strategies (Zywiak et al., 2006). ACHESSE is delivered on a smart phone, offering digital voice services along with a number of other features including text messaging, Web access, GPS, voice recognition, and video capabilities. The optimal functioning of ACHESSE also assumes access to the newer generation 3G cellular networks that provide fast access to the Internet and other mobile data services. The system transfers data from the phone to a computer

accessible by the patient's counselor or care manager, has sufficient memory to store static content and a global positioning system (GPS) technology that provides location detection services. The system is designed for people in recovery being discharged from residential care or individuals enrolled in or graduating from intensive outpatient services. In both cases, a counselor trains a user how to use ACHESSE. Specific relapse prevention services on ACHESSE include the following.

Basic Services

Though the focus of this paper is more on the innovative features of our proposed mobile relapse prevention system, a brief description of the services that were adapted from previous computer-based versions of CHESSE (basic services) follows. Thereafter, we offer more detailed descriptions of services that are currently unique to the smart phone system.

Using *Discussion Groups*, patients can exchange emotional support and information with other ACHESSE users via online bulletin board support groups. *Ask an Expert* allows ACHESSE users to receive responses within 24 hours (weekdays) from experts, in addition to request information and advice. Responses to questions of general interest are rendered anonymous and placed in *Open Expert* for all users to view. *ACHESSE Personal Stories* are professionally written as well as video accounts based on interviews of patients and family members focused on recovery experiences such as reasons for and ambivalence about relapse prevention, strategies to overcome barriers to addiction management, what they would do differently, and how they coped with challenges. *Instant Library* allows users to access detailed summaries of approximately 300 articles, chapters, and manuals on addiction management. *Medication Resource* includes information about addiction pharmacotherapies, side effects, and ways to reduce barriers to adherence (e.g., forgetting to take medications, daily techniques to remember to take medications, family or social supports in observing medication adherence with positive reinforcement, money and transportation to get medication). The *Questions & Answers* resource consists of brief answers to 260 frequently asked questions about addiction such as "Ways to overcome symptoms" and "How to find wrap-around services," with links to other CHESSE services offering more detailed support. *Web Links* allows patients to access only approved addiction-related Web sites (and specific pages within sites) with introductions covering how the site might help and its strengths and weaknesses. *ACHESSE Journaling* allows patients to either write or voice record their personal recovery experiences, with the option of later reviewing them with their counselor. *Easing Distress* is a computerized cognitive behavior therapy program currently operating on several CHESSE modules. It was adapted to the smart phone to help people cope with harmful thoughts that can stymie efforts to prevent relapse. It helps assess logical errors, attributional style, and tendencies to exaggerate distress, and offers practical exercises to improve cognitive problem-solving skills. Development

⁴The reader is reminded that from a historical perspective, this point of view and diagnostic process is relatively new and is associated with the medicalization of a range of human behaviors (DSM-IVRev); prior to "substance use disorders," such behaviors were moralized (sin), subsequently criminalized, and since the end of the 20th century categorized as chronic diseases. Editor's note.

of all services takes into account the smaller screens available on mobile devices and therefore developing content and designing interfaces so that they are optimized for a handheld device.

In the following sections, we describe the new, more innovative services that were developed specifically for the ACHES mobile relapse-prevention system.

Healthy Events Newsletter

As mentioned previously, one way to prevent relapse is to help people in early recovery feel connected to others in drug and alcohol-free recreational activities (Meyers, Smith, & Lash, 2003), and this assistance is particularly needed in early recovery when there may be little reward for abstaining from alcohol. ACHES informs individuals in recovery about these healthy events via their mobile smart phone. People's calendars are automatically populated with events that are consistent with healthy activities that they have previously expressed an interest in when setting up their preferences for the system. This is designed to enhance autonomy for people in recovery by appealing to their own internal motivations for selecting recovery-friendly activities they find pleasurable or interesting. Using social networking technology, this service also has the capability to automatically link users to other individuals in recovery who share similar interests, which help facilitate companionship and enhance feelings of relatedness while participating in activities likely to contribute to a lasting recovery.

Electronic Care Manager

Using one-on-one counselors has improved treatment outcomes in several studies (Godley et al., 2002; McLellan et al., 1999; Rapp et al., 1992; Sullivan, Wolf, & Hartmann, 1992). Additionally, electronic communication with a case manager has been shown to support behavioral change efforts of people with chronic diseases (Tufano & Karras, 2005), including addictions (Alemi et al., 1996). Research suggests that ongoing program contact can be beneficial as it provides complementary social support, in addition to teaching coping skills and providing prompts. The care management feature of ACHES is designed to increase both competence and confidence regarding coping, and reduce reliance on avoidant coping strategies as well. Because the content of ACHES is designed according to the principles of SDT (Williams, Gagne, Ryan, & Deci, 2002) and motivational interviewing (Miller & Rollnick, 1991), it is intended to support behavior change or maintenance via the patient's perception that his or her coping actions directly serve his/her intrinsic goals.

Operationally, conference calls are scheduled with the patient's care manager when he or she first gets access to the intervention. This service is intended to be a low-cost way for treatment providers to stay in touch with clients and help people avoid the relapses that are common with alcohol-dependence disorders. Some states (e.g., Rhode Island) have already begun to pay for continuing care and

to reimburse counselors for such work. Before each scheduled call, ACHES (with patient permission) e-mails a report to the counselor on ACHES resources used, topics addressed, and longitudinal graphs illustrating their status over time since the last contact (e.g., negative affect, symptom-free days, symptoms experienced, and adherence to therapeutic goals such as alcohol-free days, as well as a list of issues the patient wishes to address). The care manager contacts begin by reviewing the reports and providing education (e.g., dealing with a particular trigger) tailored to their needs. Following scheduled calls, the care manager creates links to relevant ACHES material and places them on ACHES for patients to access. The patient and care manager can call each other via a pre-programmed button on their phones. Care managers can be notified on their phone any time the patient's status on certain variables' exceeds agreed upon thresholds.

Tailored Information

As referred to above, providing the most relevant information to people in recovery is challenging because of the diversity of treatment programs for addiction, and because no single treatment is likely to be completely appropriate for each individual. Additionally, people with addiction disorders often have different psychological characteristics, co-occurring physical or mental problems and come from diverse social environments. Therefore, it follows that many patients in recovery may benefit from personalized treatment. However, providing the most relevant interventions to support people in recovery is challenging because of the costs of sustaining such interventions and because optimal outcomes require tailoring to each person's unique psychological, physical, and social circumstances such as self-efficacy (Maisto et al., 2006), perceived risk for relapse (Walton, Reischl, & Ramanathan, 1995), and decisional balance between perceived positive and negative outcomes of substance use (Miller & Rollnick, 1995). Fortunately, information technology makes it possible to provide tailored interventions to each person in a cost-effective manner (Doupi & van der Lei, 2003; Kreuter, Bull, Clark, & Oswald, 1999; Kreuter & Wray, 2003).

Unfortunately, many people in recovery can get placed in "one-size-fits-all" treatment based upon program philosophy, or what programs are available and affordable. Not surprisingly, however, the superiority of tailored education messages over general material has been supported across a variety of health education domains (Borland, Balmford, & Hunt, 2004; Strecher et al., 1994). Rather than providing individuals generic information about addiction, ACHES personalizes information so that people in recovery are proactively delivered only the information most relevant to their situation. ACHES tailors information by assessing patients about their intrinsic goals and situation while providing tailored options, consistent with the principles of motivational interviewing to enhance autonomous motivation.

High-Risk Patient Locator

The high-risk patient locator uses GPS technology to track when somebody in recovery is approaching an area where he or she has traditionally obtained alcohol, so they can be contacted to receive support to work through what might be a high-risk situation for relapse. To activate the service, the individual in recovery voluntarily registers places where he or she has regularly obtained alcohol in the past and also who they wish to be alerted of their physical whereabouts if they are approaching a pre-designated high-risk location for relapse as a part of the recovery plan. ACHESSE provides people in recovery choices about what actions are triggered when approaching locations that they have specified as high-risk. First, the person in recovery receives an automated, computer-generated alert to raise his or her consciousness about the situation and provide the person an opportunity to ask for additional support if needed. Second, they can configure the service so that selected supporters (e.g., family members, peer sponsors, or treatment professionals) are alerted when the person in recovery is approaching a high-risk location and offer to talk to them on the phone or meet in person if they need additional help.

Alerts/Reminders

Research shows that one of the greatest predictors of a successful recovery is retention in treatment, and longer treatment episodes are associated with better outcomes (Simpson, Joe, & Rowan-Szai, 1999). However, many people in recovery do not reliably show up to appointments or meetings. Many will end up relapsing back to using alcohol when they stop participating in treatment services, or when use begins, they stop attending treatment. Therefore, ACHESSE uses the smart phones to deliver text or voice reminders of upcoming appointments and meetings. Such reminders might significantly reduce the number of missed appointments and could prompt two-way communication so that an appointment may be rescheduled. Reminders enhance a person's sense of competence by providing support needed to work recovery-related activities into their daily routine. Other types of periodic alerts can also be set up, such as celebrating new recovery milestones (e.g., 30 days sober) further reinforcing a person's sense of agency in the recovery process or offering useful information such as a recovery "tip of the day," which could spur proactive coping or remind the individual of his/her motives for abstinence and recovery.

Ongoing Mini Assessments

Relapse can be triggered by a variety of factors including environmental cues, social pressure, emotional states, attitudes, and withdrawal symptoms. At periodic and random intervals, ACHESSE delivers ecological momentary assessments (short surveys) to determine if any of the above factors are at levels that may warrant additional support. Such proactive monitoring, collecting data with interactive voice recognition or text technology, can detect early warning signs and make the person in recovery

aware of possible triggers as well as offer different options for managing the situation to prevent a relapse.

Panic Button

If there is need for immediate help to avoid an imminent relapse (e.g., if urges and cravings become severe and they want assistance), patients could press the smart phone's "panic button." The GPS location tracker could also figuratively push the panic button if the subject is approaching a high-risk trigger location. The rescue plan established during setup with the ACHESSE system would be initiated, possibly including automated reminders to the patient (partly as a diversionary action, but also to identify what kind of help would be most valuable) and computer-generated alerts to key people (e.g., treatment agency, 12-step members, faith providers, counselor, family, friend) who may reach out to the patient via phone or in person. In the vernacular of Marlatt's model, the panic button provides a monitoring strategy for high-risk situations and initiates support to prevent a relapse or escalation to continued use.

Check-In

Initially on a daily basis, but weekly as the patient meets therapeutic goals (e.g., continued abstinence), ACHESSE displays a brief survey on the phone's screen (with audio overlay if requested) to obtain patient data on negative affect; lifestyle balance; recent alcohol and other drug use; progress toward therapeutic goals and home/work/educational responsibilities entered at setup; upcoming high-risk events and other potential triggers; motivation to stay abstinent, as well as desire to reenter treatment; and, via open-ended questions, any specific patient concerns. Once a month, ACHESSE collects data on other factors from a model we developed and tested to predict adherence such as perceptions of treatment effectiveness, side effects of medications, current support of significant others, and risks and benefits from alcohol use. The *Check-In* information is used by ACHESSE for triage and feedback. The care manager receives a summary report of Check-In data whenever they wish as well as the day before a scheduled appointment and whenever a patient reports a lapse or desire to reenter treatment. Relative to Marlatt's model, the Check-In represents ongoing self-monitoring and behavior assessment to help a person be aware of urges, and informs ACHESSE on which services might benefit them the most and when they should be delivered.

Set-up and Updates

Before using the system on a daily basis, patients, with the assistance of a counselor who becomes their care manager, enter set-up information that can be used to tailor ACHESSE to their own specific needs and preferences. Although the information gathered at set-up can do much to inform the initial tailoring of services, ACHESSE will be regularly updated to address the changing recovery needs of each individual user. Care managers can be sent user data reports and mini-assessments data, which they can

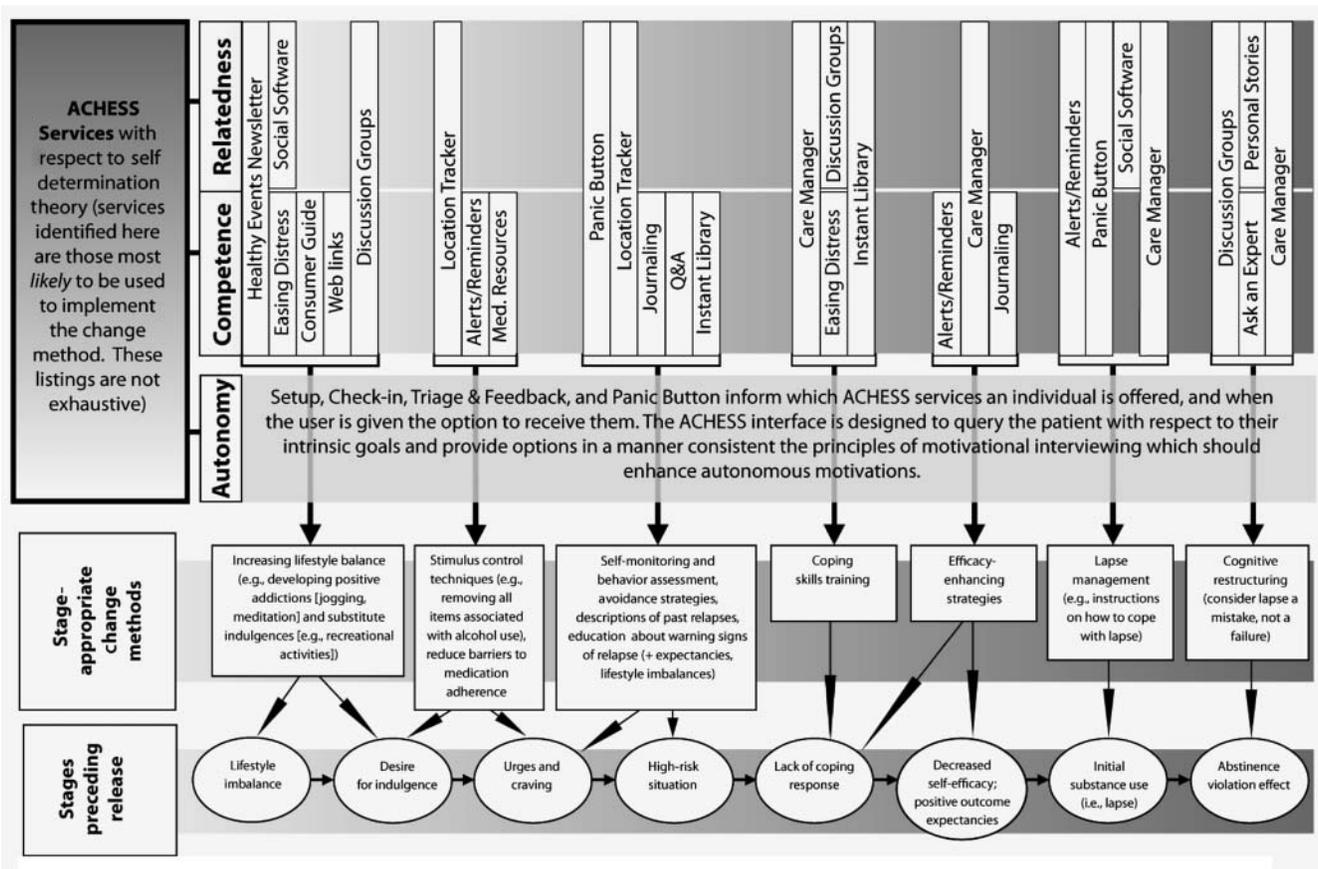


FIGURE 1. In this diagram, ACHESS services (such as healthy events newsletter, easing distress, and so on) have been added according to the change methods they provide or facilitate. Each of these examples of ACHESS service utilization addresses one or more of the three constructs of SDT, as indicated by the rows Relatedness, Competence, and Autonomy. We have collapsed Rationalization and Denial into Urges and cravings, as they overlap in the context of ACHESS.

use to supplement communications with patients as they work together to determine any appropriate changes that should be made to the initial ACHESS set-up. The patient and the care manager can review which ACHESS services are working for them and which are not, and make adjustments to protocols established at set-up. Additionally, ACHESS is programmed to automatically “recommend” additional services and resources to users based on their use data.

APPLICATION OF MARLATT’S COGNITIVE BEHAVIORAL RELAPSE PREVENTION MODEL TO ACHESS

While the SDT was used as a framework to identify *what* the essential elements of ACHESS should be, we used Marlatt’s cognitive behavioral relapse prevention model to inform the development of *when* each of the ACHESS services should be delivered.

We investigated how the ACHESS services align with the interventions suggested by Marlatt’s model in order to gain further insight into how the SDT-based services might be organized so that they can be delivered at the most effective time (in accordance with stage-based episodes), and to expand and refine the conceptualization of the services if needed.

Encouragingly, we found that the models fit together quite naturally. Figure 1 shows how ACHESS fits within both the SDT and Marlatt’s model (Larimer et al., 1999; Witkiewitz & Marlatt, 2004). The bottom row of boxes lists Marlatt’s stages preceding relapse. The row above lists the stage-appropriate change methods, again from Marlatt’s model. The arrows between these two rows show how the change methods could be applied to the stages preceding relapse (consistent with Marlatt’s model). The rest of Figure 1 is built around the three key elements of the SDT (autonomy, competence, and relatedness).

The boxes above (Health Event Newsletter, Social Software, etc.) give examples of how ACHESS services relate to SDT elements and to Marlatt’s stage-appropriate change methods. In other words, for every place where an ACHESS service is listed, there is a corresponding change method *and* a corresponding SDT construct. The service/change method relationships are *primary* examples of how ACHESS addresses the interventions suggested by Marlatt’s model, but do not include all possible examples.

For example, a suggested strategy for the “high-risk situation” stage of the relapse prevention model is self-monitoring and behavioral assessment. For an ACHESS user, this strategy might be executed by the location-tracker service, which can monitor the user’s location via

GPS and detect when he or she is near a high-risk location (e.g., favorite bar and liquor store). ACHESSE can initiate avoidance strategies (e.g., suggesting a call with a member of the user's support network). The success of such a strategy would clearly play a role in increasing the SDT construct of relatedness. So, in this case, the location tracker service is used during a high-risk situation (the *when*) to prevent relapse by addressing relatedness (the *what*).

CONCERNS AND GOALS

As mentioned earlier, the U.S. National Institute on Alcohol Abuse and Alcoholism (NIAAA) recently provided research support to develop the technology-based prototype described in this paper and conduct a clinical trial to test its efficacy. Considering addiction as a chronic illness or disorder, our core hypotheses focus on both harm reduction (e.g., reduction in substance use-related consequences, reduction in risky drinking days) and abstinence-minded outcomes (e.g., full abstinence, an increase in abstinent days). While many of the support services within ACHESSE are built on an abstinence-driven ideological model of treatment, we believe that the system can also be quite helpful for harm reduction and quality of life perspectives. In fact, the underlying theoretical foundation of all CHESSE modules is SDT, which has the goal of improving quality of life. ACHESSE is designed to raise autonomous motivation, competence, and relatedness, essential (from an SDT perspective) to improve quality of life for people diagnosed with alcohol dependence. ACHESSE is designed to warn, rescue, and prevent relapse, all of which are key elements in both abstinence and harm reduction approaches.

Additionally, we will explore several other issues during this project. First and foremost, some may question whether patients with limited resources will be likely to use a technology-based system such as the one proposed here. Encouragingly, as reported earlier, we found evidence in our research in other health contexts that patients with the greatest needs appear to be more prolific users of technology-based education and support systems (Gustafson et al., 2002; Shaw et al., 2006, 2008).

Readers may also question whether users of the ACHESSE intervention will use smart phones for purposes such as obtaining illicit alcohols or connecting with friends who are going out to drink alcohol. Of course, mobile phones are one way in which people can engage in such activities. On the one hand, many people already have cell phones so providing them another device is unlikely to significantly impact this risk. Moreover, the phones we provide to our subjects can limit the numbers they can call or receive, and the browser can restrict the Web sites they can visit. While we hope this will prevent study participants from using their phones for illicit purposes, some risk will no doubt remain. We will follow this issue closely during the course of our study.

Some readers may question the ethics of offering features such as location tracking, which may be criticized as being overly intrusive into people's lives. We have asked ourselves the same question, and, in preparing this pro-

TOTYPE, we conducted focus groups in three states with 48 people addicted to alcohol and other drugs. The majority was quite open to GPS tracking if the data were only shared with their permission—as is our intent. Indeed, using the parlance of Marlatt's cognitive behavioral relapse prevention model (Marlatt & George, 1984), location tracking is expected to empower stimulus control techniques, making the individual in recovery aware when they are nearing a location previously identified as high risk.

Readers may also wonder what factors moderate the impact of ACHESSE on the outcomes of interest. In other words, when and with whom can CHESSE be expected to work and not work? Potential moderators include motivation to recover, severity of dependence, psychological problems such as depression, and demographic variables such as gender, age, and income. After substantial discussion, we hypothesized that autonomous motivation to recover and severity of dependence would moderate the effect of ACHESSE. We chose these because we felt they were likely to encompass many other candidates. Time will tell.

Finally, even if our proposed system improves outcomes for people with alcohol-dependence disorders, readers may ask themselves whether such a mobile-technology-based relapse prevention system would ever be broadly disseminated, given the ways that treatment providers are currently compensated for their services. We believe that payers will not even consider this debate until there is evidence that such systems hold the promise to cost effectively improve outcomes.

As we further explore these issues throughout the clinical trial period and beyond, it is our hope that we can develop innovative approaches to relapse prevention that allow patients to have anywhere-anytime access to evidence based, effective treatment—just by reaching into their pocket.

Declaration of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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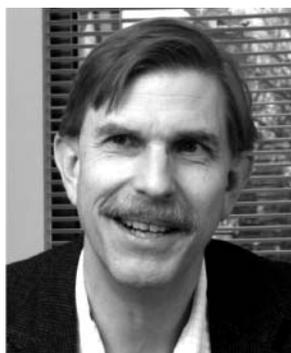
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Timothy B. Baker, PhD, is Professor of Medicine in the University of Wisconsin School of Medicine and Public Health. His principal research goals are to increase understanding of the motivational bases of addictive disorders and to develop and evaluate treatments for such disorders. He is also highly interested in developing and using technological advances to deliver effective treatments

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GLOSSARY

CHESS: The Comprehensive Health Enhancement Support System (CHESS) is an umbrella term for eHealth systems developed at the University of Wisconsin to help people (patients and their informal

caregivers) cope with serious illness. ACHES refers to “Alcohol-CHES” and is the mobile-phone-based CHES program aimed at relapse prevention for alcohol-dependent people.

Coping: This refers to individual behavioral and/or cognitive responses to manage stressors. ACHES prompts people in recovery from alcohol dependence to use more active coping strategies to prevent relapse.

GPS: Global positioning system (GPS) is a satellite-based technology system that can detect the location of an enabled device within a range of 15–70 feet. Most mobile phones have a GPS system included within them that allow their location to be identified.

3G Networks: This term refers to the “third generation” of currently available cellular networks that offer high data transmission speeds allowing for Internet access and real-time video.

Intrinsic Motivation: This term refers to internal/personal factors that energize and drive goal-directed behavior. For this paper, it relates to enhancing autonomous motivation that comes from within to motivate recovery, rather than extrinsic motivation, which comes from outside (such as social pressure from friends or family or mandates from the criminal justice system).

Motivational Interviewing: In the context of alcohol treatment, motivational interviewing refers to a question-and-answer method of interviewing aimed at increasing the patient’s motivation to change, leading to abstinence or reduced levels of substance abuse.

Relapse Trigger: An experience that may stimulate cravings, bringing back thoughts, feelings, and memories about drug or alcohol abuse and can affect any individual in recovery who encounters people, situations, or settings associated with past substance abuse.

Recovery: For the purposes of this paper recovery connotes a process of returning to health such that alcohol abuse and related behaviors are no longer problematic in an individual’s life as measured by harm reduction (e.g., reduction in substance abuse-related consequences, reduction in risky drinking days) and abstinence-minded outcomes (e.g., full abstinence, an increase in abstinent days).

Self-Determination Theory: A theory of individual change built around the concept that change is more likely to take place if it comes from within. It has three basic elements:

1. Relatedness is the need to experience connection to others.
2. Competence is a combination of having the skills necessary to address challenges in particular behavioral domains along with self-perception of such competence.
3. Autonomy is the sense that one’s actions and experiences are volitional rather than controlled by strong external forces.

Smart Phone: A cellular telephone with built-in applications and Internet access. Smart phones provide digital voice service along with other features such as text

messaging, e-mail, Web browsing, still and video cameras, calendars, and media players. Smart phones have become application delivery platforms with many of the features of a mobile computer.

Tailoring: This term refers to any combination of information and behavior change strategies intended to reach one individual, based on characteristics unique to that person, related to the outcomes of interest, and derived from an individual assessment. Technology makes it possible to affordably personalize information so that individuals receive information that is most relevant to their situation.

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