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Potential Roles for New Communication Technologies in Treatment of Addiction

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Abstract

Information and communication technologies offer clinicians the opportunity to work with patients to manage chronic conditions, including addiction. The early research on the efficacy of electronic treatment and support tools is promising. Sensors have recently received increased attention as key components of electronic treatment and recovery management systems. Although results of the research are very promising, concerns at the clinical and policy level must be addressed before widespread adoption of these technologies can become practical. First, clinicians must adapt their practices to incorporate a continuing flow of patient information. Second, payment and regulatory systems must make adjustments far beyond what telemedicine and electronic medical records have required. This paper examines potential roles of information and communication technologies as well as process and regulatory challenges.

Introduction

Estimates of the nationwide costs of 60 major illnesses put alcohol abuse as the second and drug abuse as the seventh most costly health problem in the United States [1]. Research also indicates that substance abuse increases patient and family vulnerability to—as well as the

cost of treating—other serious health problems [2]. Taken together, substance abuse costs the United States more than 346 billion dollars per year, or more than the expense of cancer and diabetes combined [3]. As we begin a national effort to contain health care costs, we must develop and rapidly disseminate practical and effective treatments and supports to reduce substance abuse and the burden of substance use disorders.

One promising tool is information and communication technology (ICT), also referred to as e-health. ICT refers to technologies that provide information through telecommunications such as the Internet, wireless communications, cellular phones, tablets, and other communication media that unify computer processing and social networking. ICTs being developed and tested for addiction treatment vary from video counseling to computer-programmed cognitive-behavioral therapy (CBT) to medication monitoring and reminder systems and Internet support groups. Patients with substance use disorders can benefit from ICTs during the identification of the disorders and during the acute and post-acute phases of treatment. Mobile technologies (eg, smart phones and tablets) in particular offer promise with their portability, allowing for immediate intervention and continuous access to support systems.

Information and Communication Technologies

ICTs may be cost-beneficial in acute treatment and continuing care [4]. Studies of ICTs in chronic disease self-management are promising in terms of user interest and treatment effectiveness [5••, 6]. Patients acknowledge more drug use and psychiatric symptoms online than in face-to-face interviews [7]. Computerized screening and brief interventions have increased motivation and reduced problem drinking [8–10]. Technologies such as interactive voice response systems have been used successfully to provide prompts and collect data from individuals dealing with substance misuse [11]. ICTs can boost motivation via social support [12–14]. Informational and emotional exchanges through ICTs have been linked to a range of positive health outcomes [15, 16]. A recent review found positive outcomes in 29 of 32 randomized controlled trials (RCTs) of personal computer and single-service (eg, texting) cellular phone ICTs for managing chronic disease across diabetes, cancer, heart failure, smoking, pain and depression, and alcohol and other drug abuse [17• •]. Although these studies are encouraging, sample sizes were generally small, and only one study addressed cost-effectiveness [18, 19]. RCTs of smart phone systems to address addiction are just beginning to appear, with only two relevant National Institute of Health–funded addiction RCTs under way according to the National Institutes of Health Research Portfolio Online Reporting Tools [20]. One is a small (*n*=25) smart phone addition to the RCT of a therapeutic educational system (TES) conducted by Bickel et al. [21] (CTN0044) and described below. The second is a National Institute on Alcohol Abuse and Alcoholism–funded project discussed later in this paper. Hence we have a long way to go to establish a foundation of research that will allow us to fully assess the impact and to understand the efficacy and cost-effectiveness of these systems across the continuum of care.

Information and Communication Technologies in Acute Treatment

Two key aspects of acute treatment are education and counseling. One evidence-based example of an ICT for acute care is TES, a computerized educational system built around the community reinforcement approach (CRA). It is used to give patients skills to achieve and maintain abstinence and improve social functioning. TES has been tested in an RCT and found to be as effective as therapist-delivered CRA at a reduced cost [21]. TES has a self-training module that produces an individualized treatment plan for each participant. It provides 65 text- and audio-based modules that include education, role playing, exercises, and homework for issues such as constructive feedback, refusal skills, healthy routines,

trigger management, and coping with thoughts about using drugs. Information about system use and progress is shared with therapists. TES has been tested primarily on a computer rather than a mobile device, except for the small trial mentioned previously.

CBT is a form of therapy frequently used in treatment of patients with substance use disorders. The goal of CBT is to help patients understand and change the thoughts and feelings that influence their behaviors. CBT typically includes stress management, problem solving, goal setting, pacing of activities, and assertiveness training. CBT has great potential as a treatment modality delivered through ICT. In an RCT of 77 patients randomly assigned to treatment as usual (TAU) or TAU with access to a computerized CBT program (CBT4CBT), patients in the CBT4CBT group were more likely to have urine specimens negative for any drug and to remain abstinent longer than the patients who received TAU [22••]. A follow-up study indicated that these effects were maintained [23]. CBT4CBT has been tested only on the computer platform.

Continuing Care

If we truly believe that addiction is a chronic disease, then acute treatment is just the beginning of care. Patients also need continuing care for sustained recovery. The success of continuing care is marked by long duration [24, 25], assertive outreach [26], monitoring [27–29], prompts [30–32], action planning [33–35], case management [36–38], and peer [39, 40] and family support [41]. Although continuing care can improve health and reduce health care use [42], it has not been widely used in addiction treatment [43–45]. When it is available, continuing care programming may address only a subset of these characteristics, be inconsistent, offer information that is difficult to recall, have answers that are difficult to find, and be unavailable when needed [46]. Cost, geographic distance, and lack of time and peer or family support may inhibit participation in continuing care programs. Addiction treatment and primary care are both labor-intensive fields with few available resources [47]. The current delivery model makes it difficult to provide high-quality continuing care [48]. Innovative solutions are needed to make continuing care a more standard part of treatment [49].

ICTs can play an important role in overcoming these deficits. One ICT that has been evaluated extensively is the Comprehensive Health Enhancement Support System (CHESS). For 25 years, the Center for Health Enhancement Systems Studies at the University of Wisconsin-Madison (an NCI-designated center of excellence in cancer communication research) has developed and tested ICTs to improve health behaviors, quality of life, and access to care for several disease groups, including cancer, asthma, HIV/AIDS, and addiction (http://www.chess.wisc.edu). The ICT it has developed combines informational content with social networking and real time messaging tools. It uses an evolving platform based on extensive needs assessment studies [50–52] that is made available to patients and family caregivers [53–55]. In randomized efficacy trials, CHESS significantly improved 1) quality of life and self-efficacy for women with breast cancer compared with control and Internet groups [56, 57], 2) quality of life and costs of care in people with HIV [18], 3) asthma control for young children (mediated by relatedness) [58], and 4) quality of dying and survival length for lung cancer patients (mediated by competence) [59]. Smart phone forms of CHESS are currently in RCTs on colon cancer, childhood asthma, and alcohol dependence.

A National Institute on Alcohol Abuse and Alcoholism–funded study of Addiction CHESS (ACHESS) uses a smart phone–based continuing care system based on Marlatt's relapse prevention model [19] and self-determination theory [60]. ACHESS services include all the elements listed earlier that are essential to continuing care. It offers easy anytime/anywhere

access to 10 services tailored to meet patient, counselor, and primary care needs. Table 1 shows the services and where the data come from (F) and where they go (2). Services come in text and audio–video formats [61]. The following ACHESS services were derived from elements of the two theoretical models upon which it is based. Coping competence services include a global positioning system (GPS) that tracks current location and intervenes with an intervention tailored to the user when the person has a prolonged stay in a high-risk location. Ecological momentary assessments of protective and risk factors lead to tailored tools and information (eg, CBT, relaxation audio files, one-touch dialing to supports) [62]. The healthy events calendar prompts patients to participate in healthy activities that were identified during treatment, and encourages communication and data sharing with providers (randomly, if indicators exceed a threshold [eg, GPS indicating sustained time in a high-risk location], and prior to an appointment). Intrinsic motivation services include avatar-facilitated motivational interviews that elicit and use a patient's perspective to provide options and rationales for advice given [63–65]. My recovery motivation—a picture, quote, or audio file—reminds the patient of his or her own motivation for recovery. Social-relatedness services include a one-touch link to providers, supporters and peers, video counseling, phone, e-mail, and text. While clinician-to-patient contact is part of ACHESS, most uses require no direct contact with clinicians. Patients are responsible for using ACHESS services, but the clinician or care provider can offer the patient reminders, a thought for the day, or periodic assessment. ACHESS also contacts clinicians if, based on survey responses, the patient appears to be at risk or likely to miss an appointment. A brief video can be viewed at http://chess.wisc.edu/chess/projects/addictionchessvideo.aspx.

Sensors

Sensors that detect an impending lapse can dramatically increase the effectiveness of smart phones and tablets. Relapse can come quickly and with little notice, even for a patient who appears to be doing well. A patient overcome by relapse triggers or craving can easily forget relapse plans and return to old coping mechanisms. Future continuing care initiatives will need to detect onset of a lapse in real time or predict relapse before it happens and be able to react instantaneously. Sensors that are commonly built into smart phones or can be easily connected to smart phones show promise in this regard.

Repurposing Existing Sensors

Most smart phones now come with several built-in sensors: cameras, microphones, GPS, accelerometers, and magnetometers. These sensors are not designed to gather clinically relevant data; however, they may be capable of being repurposed to monitor for indicators of impending or recent relapse. These indicators, captured in real time, could be used to initiate a preventive response delivered via smart phone or another mechanism [66]. Existing smart phone sensors might be repurposed to detect impending relapse using heart and respiration rate measured through basic webcams [67], which are now included on many smart phones. Diaphragmatic breathing may be monitored using a standard ear bud–mounted microphone to indicate stress levels [68]. Accelerometers may be used to detect fasciculations (twitching) to indicate stimulant use or tossing and turning in bed to detect sleep quality. GPS could alert proximity to or presence at a bar at which a patient used to drink alcohol.

Existing Add-on Sensors

The potential of common smart phone sensors to detect clinically relevant data demands further exploration, as the cost of adapting existing sensors is minimal, yet these common smart phone sensors may lack the sensitivity to capture important moments, or may not be capable of measuring the most useful clinical metrics. Sensor hardware designed to connect to smart phones could be added as a peripheral to monitor key metrics. For example,

physiologic monitoring devices designed for weight management that measure skin temperature, motion, galvanic skin response, and heat flux may be able to indicate negative affect, a predictor of relapse [69]. Smart phone breathalyzer-like accessories may estimate blood alcohol levels. Continuous transdermal alcohol monitoring, usually in the form of an ankle or bracelet sensor, may estimate the blood alcohol level of the wearer by tracing the ethanol concentration in perspiration. The secure continuous remote alcohol monitoring device is among the most popular used by law enforcement [70]. Such a device could be repurposed to communicate with health care providers or patient supports to initiate a health care intervention rather than a law enforcement response.

Developing New Sensors

Even if no sensors currently exist that can be used to gather key relapse indicators, they may be developed and tested specifically for such a purpose. Wearable, unobtrusive sensors are currently being developed and tested to monitor physical, cognitive, and emotional stressors [71, 72••]. The sensors found in smart phones will only become cheaper and more ubiquitous as time passes and the technology advances. Soon, most people will be carrying phones that contain sensors, whether or not sensors are leveraged to gather useful clinical data. If an abundance of such data were gathered, software holds the potential to identify important indicators and to initiate an appropriate response. All of this means that we may soon be able to attain the benefits associated with long-term, real time monitoring of individuals in recovery at negligible costs.

Decision Models

It is one thing to collect data and quite another to accurately use those data to predict relapse and other outcomes. Data will often come from a variety of sources (eg, accelerator, GPS, magnetometer, patient surveys). Several statistical modeling strategies are available to combine such data. For example, very early results suggest that using Bayesian statistical models [73, 74] to combine Brief Addiction Monitor scores and data from ACHESS may be able to predict the onset of relapse [58]. For ICTs to reach their full potential, decision or prediction models that transfer data into usable information will be required.

Barriers to Adoption

In order to make ICTs more widely available for patient care, several critical issues must be addressed. One is how care providers adapt their practices to utilize ICTs in the best way. For example, health systems that adopt electronic medical record systems must adapt clinical and administrative processes [59]. Systems that have not adapted their processes have less than full implementation of their electronic medical records [75]. Technology that directly impacts the process of care, the patient–provider relationship, and patient engagement in the management of his or her own care may have a greater impact on the patient care process than electronic medical record implementation has. Organizations will need to reconfigure how clinicians review, use, and record patient information from an ICT, particularly if they offer sensors that monitor biological factors and communication systems that are expected to provide the patient with rapid response to problems such as relapse triggers. Developing care delivery systems that make effective use of this continuous flow of information from ongoing rather than periodic contact with the patient without stressing care providers with information overload is critical to successful dissemination of ICTs.

One concern of health care providers is reimbursement. Video counseling is one service that is already reimbursable in some health care systems, but payment is generally made through a fee-for-service arrangement for the time a counselor spends on the computer with the patient or in consultation with another care provider [76]. As ICTs become available to

address more chronic conditions, there is a keen interest in determining how to reimburse for automated services. Key research issues are whether the technology can improve patient outcomes over the long term and reduce cost of care [77]. Payers are unlikely to cover the costs of a service that cannot demonstrate both.

Most addiction treatment is designed as an acute care system with specific levels of care outlined in statute and regulation. State statutes regulate lengths of treatment stays, services that are required or allowed to be provided, restrictions on care provider education, licensing, number of patients to be seen at a given time, and number of patients a given clinician can carry. These regulations as well as cost considerations limit the adoption of ICTs by limiting their usefulness in the current treatment system [78]. For example, most states have regulations that require discharging a patient from addiction treatment if there has not been a visit in a specified length of time. These regulations are a relic of the days in which care was primarily hospital based or residential. Providers testing ACHESS are grappling with the regulatory requirement to discharge patients at the end of formal treatment while maintaining contact and responsibility for patients through electronic means. Some, but not all these barriers exist in the primary care system as well. ICTs have the ability to transform the patient–provider interaction, possibly allowing for longer but less intense lengths of treatment in the specialty care system and true chronic care management by a primary or specialty care provider. They may allow clinical staff to carry a larger caseload of patients with less acute but greater continuing care needs. As research demonstrates the ways that ICTs can change the way care is delivered, regulators and payers must stay up to date with rapidly changing technology to ensure that regulation and reimbursement systems do not inhibit improvement of patient care.

Conclusions

ICT is a rapidly evolving set of tools that offers important opportunities to improve the treatment and management of substance use disorders. Computer-based CBT and CRA have been shown to be efficacious in treating substance use disorders, and smart phone applications have helped manage other chronic diseases and are under investigation in treating substance use disorders. New technologies currently being developed hold great but unknown potential. A great deal of research remains to be done on the effectiveness and cost/benefits of ICTs as applied to the treatment of substance use disorders. However, the evidence is rapidly developing, and dissemination has already begun.

Technology holds the promise of providing service to more people, to people in remote areas, and to people with limitations that prevent them from participating fully in services as they are currently structured. In addition, mobile technologies provide go-anywhere, always-available access to support; push technology that can deliver content or services on a random or scheduled basis; and sensors that can identify troubling times, geographic locations, or physical states and intervene as needed. Mobile technologies offer a solution to the perennial problem of chronic disease: the patient always needs to manage it, but the care provider cannot always be present.

With ICTs, treatment providers could have access to significantly more data regarding a patient's condition. This could improve the quality of care or overwhelm the provider with too much information to adequately process and react to. Research must be conducted on how providers adjust their practice to increased contact with patient information. Tools need to be developed that synthesize the multiple data sources into information that is useful to the provider and to the patient.

A key to widespread adoption of ICT solutions is a transformation of the regulatory and funding environment to support continuing care and interactions that are not face-to-face, may cross state boundaries, and may be intermittent but extend over a long period of time. The US Food and Drug Administration is still struggling with whether and at what point ICTs become medical devices that require regulation for safety and efficacy. The rapid rate at which these technologies are evolving pushes the limits of slow-moving regulatory systems to respond.

Policymakers and payers will seek data on costs as well as benefits before they will be willing to address regulation and reimbursement. Addiction often leads to crime and health problems such as infections, dental issues, and HIV. The few economic analyses of continuing care generally yield positive results [79–82] but focus on 1) special populations (eg, prisons), 2) only one of several important outcomes, 3) small sample sizes that limit power and nonequivalent control group designs, 4) short-term follow-up (although alcohol and other drug dependence is a chronic disease), and 5) patients who complete continuing care (ie, the studies do not employ an intent-to-treat design) [83]. For ICTs to become a standard of care, research must overcome these deficits and have real comparative effectiveness studies of smart phones and other ICTs in treatment and relapse prevention [84].

ICTs represent an exciting and promising development in the treatment of substance use disorders. The technology is advancing rapidly, but whether it is adopted widely depends on a host of technological and nontechnological factors that must be addressed effectively if we are to achieve the promise.

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Table 1

Addiction CHESS services information flow[a]

	CHESS	Patient	Counselor	PCP	Supporter
One-touch contact	2	F/2	2		2
Video counseling		F/2	F/2	F/2	
Phone/text/mail		F/2	F/2	F/2	F/2
Expert advice		F/2	F/2	F/2	
Discussion group		F/2	F/2	F/2	
GPS rescue	F	F/2	2	2	2
Assessment	2	F	2	2	
Tailored information/tools	F	2	F		
Prompts/alerts	F	F/2	F/2	F/2	2
Event calendar	F/2	F/2	F		

[a]"F" indicates where data come from, whereas "2" indicates where the data go to

CHESS—Comprehensive Health Enhancement Support System; GPS—global positioning system; PCP—primary care provider