Alcohol Alert

National Institute on Alcohol Abuse and Alcoholism

Number 88

eHealth Technology and What It Means for the Alcohol Field

Technology is transforming the way we live and work. Computers, the Internet, smartphones, and ever-emerging mobile, digital, and other electronic technologies are now an integral part of everyday life—from ordering a pizza to managing finances. These technologies also are changing how research is done and how we approach the prevention, intervention, and treatment of alcohol use disorder (AUD).

Electronic health (eHealth) technologies are poised to transform theories of behavior change and models of behavioral health care through real-time monitoring of physical and cognitive states and delivery of personalized interventions that can prevent relapse when and where needed.[1] Researchers can track and measure alcohol use more precisely than ever before, thanks to technologies like computerized assessments, sensors that continuously track alcohol use, and smartphone apps that prompt study participants to respond to questions. Along with computerized screenings and interventions, these and other new systems may strengthen efforts to prevent alcohol's negative consequences, including AUD and driving under the influence. And Web-based and mobile AUD therapies seem equally promising, potentially offering less expensive access to treatment for underserved populations.

Although eHealth technologies hold great potential for improving the monitoring, prevention, and treatment related to alcohol use and AUD, they also pose challenges.[1] Some of the new monitoring devices generate so much data that researchers and clinicians will need new techniques for analyzing and efficiently using what they collect. Ethical questions also come into play, as developers work to ensure patient/subject privacy and confidentiality.

This *Alert* explores both the potential of these technologies and the challenges they present.

Tracking Alcohol Use in Real Time

eHealth technologies allow real-time monitoring to more accurately assess how, when, where, and under what circumstances people use alcohol. With data from eHealth devices, researchers and clinicians eventually may be able to predict risky behaviors and supply interventions when they can be most effective.

Digital health technologies (DHTs) (see textbox) present researchers with more accurate and precise measures of alcohol use than those gathered through traditional self-reporting. These technologies can be combined to create what researchers call ecological momentary assessment (EMA), which uses technologies such as mobile and electronic diaries, personal data assistants, global positioning system (GPS) tracking, and smartphones for assessing moment-by-moment location and alcohol use, as well as wrist and ankle monitors that gather real-time information about blood alcohol levels (BALs).

Ecological Momentary Assessment (EMA) refers to a diverse family of assessment approaches that measure behavior in as close to real time as possible as participants go about their daily lives.[2] Modern EMA research often calls on a range of assessment strategies that combine new, high-tech methods, including

apps embedded in mobile devices, with older methods gleaned from intensive longitudinal research, including experience sampling, self-monitoring, and diaries. The new techniques can capture momentary states, such as shifts in stress and cravings, and help avoid the bias that often is found when people try to recall their past alcohol use.[3]

EMA's goal is to chart the factors that influence excessive drinking with the aim of preventing excessive drinking. They do this by sampling and capturing data on when, why, and how people drink, in real time. For example, EMA methods can obtain data on a variety of momentary influences on alcohol use, including shifts in stress, affect, drinking motivation, cravings and urges, and environmental and contextual factors.[2,4] These data can provide a richly detailed picture of factors associated with different patterns of alcohol use, including drinking until highly intoxicated, in both adolescents and adults.[5]

Technology Terms

As research moves forward with the use of eHealth technologies, the rapid pace of their evolution affects the language used to describe them. The terms eHealth and mobile Health (mHealth) are somewhat interchangeable with each other, as well as with the term digital health technologies (DHTs), which often is used to encompass the breadth of these technologies.

The technologies used today include smartphone apps, GPS, and interactive Web sites that researchers and clinicians can use for techniques such as ecological momentary assessment (EMA) and ecological momentary interventions (EMIs) (see text for definitions).

Combining EMA with geospatial data can offer detailed information on alcohol use in different drinking contexts, allowing researchers to better identify conditions under which drinking and problems related to drinking occur.[6] Although potentially powerful, EMA is not foolproof. It may provoke "measurement reactivity" in which people change their behavior when they know they are being monitored, or people may be unwilling to comply with EMA protocols. Devices also can fail, leading to missing data.[2]

To validate the accuracy of self-reported alcohol consumption measurements, even those recorded in real time, researchers also have begun to use noninvasive biomonitoring approaches that indirectly estimate BALs by measuring alcohol vapors emitted through the skin.[7] Two such devices currently are available: WrisTAS™, which fits around the wrist; and SCRAM™, which fits around the ankle. WrisTAS™ has relatively high failure rates. In one study, for example, WrisTAS™ did not function properly 43 percent of the time.[8] SCRAM™ seems to be reliable and generally more accurate, with its sensitivity increasing as BALs increase.[7] One study found that SCRAM™ accurately detected 57 percent of drinking episodes when BALs reached 0.02 to 0.08 g/dL, and 88 percent of the episodes when the BALs exceeded 0.08 g/dL.[9,10] Device makers continue to improve reliability and accuracy, making their products valuable tools for measuring alcohol consumption, particularly in conjunction with other measurement instruments.[7] The National Institute on Alcohol Abuse and Alcoholism recently released two research funding announcements (RFA–AA–15–007 and RFA–AA–15–008) to stimulate the continued development of such devices. NIAAA has also issued the Wearable Alcohol Biosensor Challenge. The winning prototype is expected to improve on existing technology by providing real-time monitoring in an inconspicuous package appealing to the general public.

The goal of real-time monitoring is to assess alcohol use so accurately that researchers and clinicians can predict risky behavior and offer timely and effective interventions. But that will require new data storage and analysis techniques for interpreting and using this kind of "big data," such as those being developed by machine learning and systems science researchers.[1]

Prevention

Accurately tracking alcohol use patterns is an important first step to designing better interventions to prevent alcohol use problems. Once researchers more clearly understand the contexts that often lead to drinking problems, they can design prevention efforts with those in mind.[6] For example, can certain patterns of social media usage predict whether an adolescent might engage in risky drinking or any drinking? In addition, mobile technology can offer easily accessible screening and brief interventions (SBIs) that show

promise for preventing AUD.[11–13] Integrating new technologies with more traditional techniques may enhance the effectiveness of some prevention programs.

Screening and Brief Intervention (SBI)

SBIs assess drinking levels, offer feedback, and, if necessary, offer advice to cut down or quit drinking. They are widely considered a first step in preventing AUD.[12,13] Electronic and mobile technologies that make SBIs convenient and more accessible may reach far more people than traditional face-to-face and paper-and-pencil methods. Research on electronic SBIs has focused on two main areas: drinking on college campuses, and screening for patient alcohol use by medical personnel, as described below.

College Settings. One in-person college prevention program, Brief Alcohol Screening and Intervention for College Students (BASICS), effectively targets high-risk drinking. Because colleges and universities often do not have the resources to administer BASICS to large groups of students, researchers have developed several electronic versions that can be delivered to entire cohorts through the Internet or other electronic platforms.[12] Studies find that some versions of electronic SBIs, particularly those that directly translate components of in-person BASICS, could help reduce alcohol use and its associated negative consequences.[12] However, more data are needed to make general recommendations on the best program for adoption.[12]

Health Care Settings. Electronic SBI tools could potentially expand alcohol screening in medical settings, where clinicians often lack time and training to implement traditional SBIs.[13] Electronic SBIs in medical settings have been tested in several populations, including adults, pregnant women, and adolescents, and research shows that these patients find SBIs acceptable.[13] That said, there is limited evidence that electronic SBIs are effective in modifying alcohol use.[13]

Preventing Driving Under the Influence (DUI)

Since the early 1990s, law enforcement agencies have used interlock devices on cars to prevent DUI offenders from starting their cars if they have been drinking. The devices decrease recidivism by two-thirds.[14–16] Still, one-third of DUI offenders continue to drink and drive, finding ways around interlock devices by driving someone else's car or having someone else start their car. They quickly revert to driving under the influence once their sentences are up and the interlock devices are removed. In addition, if given the option, many offenders choose to avoid the interlock devices altogether and instead have their licenses suspended. Research shows that new technologies such as smartphones and wireless applications can enhance the effectiveness of interlock devices through stricter oversight.[14] Examples include data systems that record both driver actions and vehicle responses, miniature cameras and face recognition to identify the user, WiFi systems for rapid reporting on offender performance and any attempt to circumvent the device, GPS tracking of the vehicle, and more rapid means of monitoring the integrity of the interlock system. Law enforcement has begun to use devices such as SCRAM™ (described above) to more closely monitor DUI offenders at all times of the day and night.

Treatment

The need to combine technology with more traditional techniques is most evident in the context of alcohol treatment. Although their use in alcohol treatment holds much promise for reaching people who might otherwise go untreated, digital health technologies (DHTs) may work best in conjunction with traditional methods, including human support, particularly for people with more severe alcohol use problems.[17]

DHTs to support alcohol treatment currently include the following:

- Electronic screenings, intake forms, or appointment schedulers that ease a patient's entry into traditional treatment.
- Electronic cognitive–behavioral therapy (CBT) or other treatment apps that may enhance traditional in- or outpatient care by standardizing some portions of therapy or, in some cases, creating an entire treatment protocol.[18,19]

» Electronic tools, including ecological momentary interventions (EMIs), which can extend care beyond the clinic by keeping people engaged and facilitating long-term continuing care.[3,17,20]

Research results are mixed on how effective these technologies are. There is clear evidence that DHTs benefit people with less severe alcohol problems, but little evidence that, on their own, DHTs are helpful to those whose alcohol problems are more challenging.[17] In addition, DHTs that do not include provider accountability or proactive prompts and alerts have extremely high attrition rates, with real-world trials finding that as many as 90 percent of patients stop using the DHTs after 6 months.[17] Newer mobile interventions that include prompts and human support seem to engage users better than older, primarily Web-based interventions, highlighting the power of combining DHTs with provider support.[17]

Researchers have developed several electronic versions of cognitive behavioral therapy (CBT) aimed at treating AUD by computer or tablet. Such programs can potentially involve patients who may not otherwise access therapy.[18] However, evidence of program effectiveness is still lacking. Of all the programs, a multisession CBT offered through the Web shows the most promise, but it fares best when combined with more personal feedback, including Web-based chats.[21]

Post-treatment Followup

Once people leave therapy, achieving sustained abstinence is difficult, with rates historically found to be as low as 15 percent or even less.[3,22–24] To help prevent relapse, researchers, clinicians, and commercial companies have created apps, programs, games, and other types of DHTs for follow-up support post-treatment. Unfortunately, most studies suggest that commercially available mobile interventions, such as apps found in the iPhone or Android marketplaces, do not use evidence-based strategies, and even those based on research have limited long-term impact and high attrition rates.[17,25,26] The strongest evidence of efficacy to date supports the use of DHTs as part of in-person treatment, either as an adjunct or enhancement to traditional care. For example, A-CHESS, a comprehensive system that operates on smartphones and is designed to be integrated into clinic-based treatment, has shown promise in at least one clinical trial.[20,27] The program offers extended skills training over time based on a client's current needs, and it has a panic button for high-risk situations. A-CHESS also evaluates relapse risk based on user assessment results and/or by geolocation if users are entering a high-risk environment. Compared with interventions that simply send supportive text messages and remind people to report their alcohol use and to take medications such as naltrexone, A-CHESS seems to produce more substantial and lasting effects.[20]

Perhaps the most promise for DHTs lies in combining assessment with intervention in systems that monitor an individual patient's drinking patterns and high-risk contexts and tailor real-time interventions when most needed.[3] However, developing algorithms that accurately assess patterns and offer appropriate and timely intervention is challenging and relies not only on the quality of the vast amount of EMA data, but also on the power of the system to analyze those data.[3,28]

Figure A-CHESS is a promising new smartphone app. The program offers extended skills training over time based on a client's current needs. It includes a panic button for high-risk situations.

Ethics

The proliferation of eHealth technologies for alcohol treatment and research raises many ethical issues for both researchers and clinicians.[29] Because these technologies

can collect personal information, often in real time and through devices that may be at risk for data breaches, they create challenges for protecting the privacy of patients and research participants.

Of course, the same regulations that oversee conventional treatment and research govern eHealth research and treatment.[29] However, even with those regulations in place and with careful monitoring by clinicians and researchers to ensure data security and privacy, no system involving humans can be completely secure. Breaches will happen. There always will be a balance between security, subject usability, and research cost based on the requirements of eHealth research.[29] The eHealth alcohol research and treatment communities can learn from other related fields, including protocols developed as standards for medical devices and cybersecurity.

Conclusion

Technology holds great promise for the alcohol research, prevention, and treatment communities. This rapidly developing area already is improving the quality of the data researchers and clinicians collect from patients and research subjects by gathering information in real time. Mobile and digital SBIs and treatment protocols also could potentially reach millions of people with AUD who now go untreated, offering follow-up and "just-in-time" interventions for patients who have left residential treatment programs or who are trying to remain sober between treatment center visits. Currently, the most effective DHTs work in conjunction with human support. Much research still is needed to develop protocols that are more effective and dynamic enough to retain users over the long term.[17]

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Resources

Source material for this *Alcohol Alert* originally appeared in *Alcohol Research: Current Reviews,* 2014, Volume 36, Number 1.

Rapid advances in technology hold particular promise for the field of alcohol research—revolutionizing the way research is conducted and enabling us to design more effective intervention, prevention, and treatment for people with alcohol use disorders. This issue of *Alcohol Research: Current Reviews* reports on the state of the science and future directions in electronic health (eHealth) technologies and their potential impact on alcohol epidemiology, prevention, and treatment. As an emerging and rapidly evolving transdisciplinary field, eHealth is poised to transform the existing theories of behavioral change and models of behavioral health care. As shown in this issue, eHealth brings real-time in-the-moment monitoring of bodily and cognitive states and enables us to deliver personalized and "just-in-time" intervention.

For more information on the latest advances in alcohol research, visit NIAAA's Web site, **www.niaaa.nih.gov**