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# Technology-based Interventions for Preventing and Treating Substance Use Among Youth

**Lisa A. Marsch**[1] and **Jacob T. Borodovsky**[1]

[1]Center for Technology and Behavioral Health, Dartmouth College, Lebanon, NH

## Summary

Preventing or mitigating substance use among youth generally involves three different intervention frameworks: universal prevention, selective prevention, and treatment. Each of these levels of intervention poses unique therapeutic and implementation challenges. Technology-based interventions provide solutions to many of these problems by delivering evidence-based interventions in a consistent and cost-effective manner. This article summarizes the current state of the science of technology-based interventions for preventing substance use initiation and mitigating substance use and associated consequences among youth.

### Keywords

Youth; Substance Use Disorders; Prevention; Treatment; Technology

## Introduction

Substance use and substance use disorders among youth pose unique developmental and clinical challenges for families, providers, and youth themselves. Close to 40% of high school seniors have used an illicit drug in the past year, and 20% of high school seniors have used an illicit drug other than cannabis in the past year.[1] Youth who use substances are at risk for sexually transmitted diseases,[2] impaired cognitive functioning,[3] major depressive episodes,[4] poor educational attainment,[5] involvement in the criminal justice system.[6] and developing a substance use disorder later in life.[7,8]

Developing a substance use disorder takes time and is influenced by various risk factors and behaviors. Intervention during this development process plays a vital role in redirecting a young person's life trajectory. Intervention strategies along this trajectory include: universal prevention, selective prevention, and treatment.[9,10] The goal of universal prevention is to prevent substance use initiation (i.e. prevent youth from trying a drug for the first time).

Corresponding Author: Lisa A. Marsch, Lisa.A.Marsch@dartmouth.edu, Dartmouth Psychiatric Research Center, Rivermill Commercial Center, 85 Mechanic Street; Suite B4-1, Lebanon, NH 03766.



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Selective prevention involves identifying high-risk youth and intervening to stop problematic substance using behaviors that may escalate into a diagnosable disorder. The goal of treatment is to intervene with individuals meeting diagnostic criteria for a substance use disorder.

Numerous implementation barriers hinder our ability to deliver evidence-based universal prevention, selective prevention, and treatment interventions for youth.[11–14] Clinician-delivered treatment is expensive with variable adherence to intervention fidelity. Unfortunately, less than one-third of substance abuse treatment facilities offer adolescent-specific programs[15] and only 10–15% of youth who could benefit from treatment actually receive it.[14] Interventions that leverage computer, mobile, and web technologies are appealing to youth,[16] require minimal cost,[13,17] deliver therapeutic content in a consistent and standardized manner,[17] minimize burden on staff,[18] and can be tailored to different individuals and treatment settings.[17,19] Technology is well suited as a means of providing universal prevention,[20] selective prevention,[21] and treatment[22] interventions that can: fully or partially replace face-to-face interactions with prevention or therapeutic staff (thereby reducing costs and freeing staff to attend to more patients); or augment standard services under a “clinician extender” model that increases access and availability of evidenced based practices outside clinical settings.[23]

The widespread use of technology among youth underscores the opportunity for delivering these interventions to this cohort. Approximately 80% of youth in the U.S. have a cell phone (many of these Smartphones)[24] and over 90% have access to a computer and the internet.[24] Abroad, internet and smartphone access and use is increasing among younger age groups.[25] Given the prevalence and acceptance of technology use among youth, as well as the increased fidelity to psychotherapeutic models and cost-effectiveness, technology-based interventions fill critical gaps for preventing and treating substance use among youth.

The purpose of this article is to provide an overview of the current research on the use of technology-based substance use prevention (universal and selected) and treatment interventions for youth. Directions for future research are also identified and discussed. Website links to more information about specific interventions are provided in Table 1.

## Technology-Based Universal Prevention

Technology-based universal prevention interventions generally target youth between ages ten and eighteen who self-report never having used alcohol or other substances. These interventions often consist of interactive, digital, activities designed to increase drug-related knowledge and alter attitudes and normative beliefs around substance use[26] to try to prevent or delay the onset of substance use. They can be adapted from empirically supported interventions and delivered via computer.[27] Early studies have used CD-ROM technology to deliver an intervention, but many studies have shifted to internet and mobile technologies. The following section summarizes the patterns of findings from scientific evaluations of technology-based universal prevention interventions in three settings: primary care, schools, and homes.

## Primary Care Settings

To our knowledge, Walton et al. (2013)[28] is the only published randomized controlled study demonstrating the use of a technology-based universal prevention (i.e. no study subjects with lifetime substance use) intervention in a primary care medical setting. This randomized controlled trial evaluated the effectiveness of a computer-delivered brief intervention designed to prevent cannabis use onset among a sample of n=714 adolescents (ages 12–18) who reported no lifetime cannabis use. Youth were randomized to one of three conditions in a large urban pediatric practice setting: computer-delivered brief intervention, therapist-delivered brief intervention or control (educational brochure about cannabis use). The computer-delivered intervention consisted of animated scenarios presenting different risks for substance use and modeled positive choices. The two primary outcome measures in this study were initiation and frequency of cannabis use. A secondary outcome was frequency of other drug use. The computer-delivered brief intervention resulted in a lower cumulative proportion of cannabis use initiation at 12-months post-intervention compared to the educational brochure control (17% vs. 24%), lower frequency of cannabis use at three and six months, and lower use of other drugs at six months. The therapist delivered intervention showed no significant difference from the educational control in terms of cumulative proportion of cannabis use initiation at 12-month post-intervention (21% vs. 24%). The study was not powered to compare the therapist brief intervention to the computer brief intervention.[28]

## School Settings

**CLIMATE—**Multiple randomized controlled trials have confirmed that The CLIMATE intervention consistently produces positive prevention outcomes.[13,29] CLIMATE provides six lessons based primarily on social influence theories via CD-ROM and the web. Lessons include information about the prevalence and consequences of substance use and ways to avoid substance use and associated risks. After the computer activity, students and teachers (who require no training) collaborate in role-playing, group discussion, decision-making and problem-solving activities, and skill rehearsal.[30] The CLIMATE intervention is more effective than standard health class curricula (e.g. unstructured social influence and harm minimization materials delivered by a teacher) at enhancing primary outcomes such as alcohol-related knowledge and reducing positive expectations around alcohol,[30] cannabis,[31] and Ecstasy use.[31]

**HeadOn—**The HeadOn intervention is a substance abuse prevention program designed for youth in grades six through eight. HeadOn is delivered via CD or the internet and consists of interactive, simulated scenarios that required students to engage in substance-related decision-making. Youth have the opportunity to explore ten topics related to substance use (e.g., consequences of drug use, drug-refusal skills training, social skills training, etc.) and earn skills cards for mastering each topic. Youth use these skill cards to engage in an electronic card game designed to reinforce the substance abuse knowledge they have acquired.

The HeadOn intervention was evaluated in two schools for fifteen sessions over one school year. Two additional schools (serving as the control group) received the empirically

validated Life Skills Training substance abuse prevention program.[32] Students in both the HeadOn and the Life Skills Training intervention had positive outcomes in terms of self-reported use of cigarettes and alcohol, intentions to use these substances, acquisition of knowledge about drug use, and attitudes about drug use. However, students in the HeadOn intervention had more accurate responses to questions evaluating knowledge of substance abuse than those in the LifeSkills Training Program. Youth also reported that the HeadOn intervention was interesting, fun, and useful.[33] These findings were replicated using a modified version of HeadOn developed for a younger age group. In a similarly structured randomized trial of over five hundred youth in grades three to five, the HeadOn intervention increased self-esteem, problem-solving skills, and substance use prevention knowledge among youth.[34]

### Home Setting

Schinke and colleagues have led a systematic line of research to develop technology-based interventions that can be delivered at home.[35] By delivering technology-based interventions in home settings (usually in the form of a website accessed via a home computer) youth can engage with the intervention and their parent(s) at the same time. Thus, intervention modules grounded in family interaction theories can be effectively employed. These interventions offer the opportunity for parents to reinforce new behaviors and beliefs to foster healthy relationships by, for example, teaching mothers how to communicate with daughters to build their self-esteem, and set rules and consequences for substance use.[35] This helps youth develop better conflict management and substance refusal skills, better self-efficacy, and less alcohol, cannabis, prescription drug, and inhalant use.[35–37]

A recent exemplary intervention – informed by years of prior work[38] – is called RealTeen. This is a web-based intervention that is easily accessible from home. Youth create a username and password to access the intervention and can receive email reminders to complete modules. This intervention is designed to mitigate drug use risk factors to prevent or delay the onset of substance use by enhancing mediators of substance use prevention. It does this by using interactive skills building sessions that place youth in realistic drug use scenarios designed to improve cognitive and social skills. These scenarios help young girls avoid drug use by teaching them to cope with stress and set goals.[38,39] In a study to evaluate this intervention, n=236 7$^{th}$ 8$^{th}$ and 9$^{th}$-grade girls were randomized to RealTeen or a control (assessment-only) group. At the 6-month follow-up participants had lower rates of past 30-day alcohol, marijuana, polydrug use and total drug use.[38]

## Technology-Based Selective Prevention

Selective prevention models such as the screening, brief intervention, and referral to treatment (SBIRT) model, identify at-risk adolescents across a range of treatment settings and patient populations,[17] help them reevaluate their substance use, and provide first steps for seeking treatment.[40] For a comprehensive discussion of SBIRT interventions, refer to the article in this issue titled, “Screening, Brief Intervention and Referral to Treatment”. Technology-based selective prevention interventions fit the SBIRT model well. These interventions often contain therapeutic content adapted from validated tools like the

CRAFFT (Car, Relax, Alone, Forget, Friends, Trouble)[41] and deliver this content via a computers or tablets. Many of these interventions tailor their content based on an individual's responses.

In contrast to universal prevention interventions (predominantly school-based and focus on younger children with no lifetime substance use), few technology-based selective prevention interventions have been tested in school-age youth.[42] Most selective prevention interventions are SBIRT interventions that target youth who have already begun using substances and are primarily between the ages of 18–25. These interventions are primarily used in medical (primary care and emergency room) or university settings.

## Medical Settings

**Primary Care—**The Harris Primary Care Trial was a multi-site, international trial (with sites in New England and the Czech Republic) aimed at evaluating a computer-facilitated screening and brief advice system (cSBA) in a primary care setting.[43] Youth (aged 12–18) attending routine primary care were eligible for the study. The trial evaluated both substance use initiation and cessation (making this a universal and selective prevention trial). The cSBA system is based on the CRAFFT tool and requires participants to complete a questionnaire about their substance use. The cSBA system uses this information to calculate a risk score and automatically provide the physician with tailored talking points on substance-related health risks and advice on how to promote conversation with the participant about substance use. Participants in the control group received treatment as usual specific to the clinic providing care. At 12 months, the cSBA system produced better alcohol initiation and cessation outcomes at the New England sites and better cannabis initiation and cessation outcomes at the Czech Republic sites.[43]

**Emergency Room—**Approximately one fourth of youth in emergency departments screen positive for risky drinking behaviors.[44] Additionally a large majority of college drinkers sent to university emergency departments are willing to receive a brief alcohol use screening – half of whom will screen positive for alcohol use problems and are open to receiving counseling.[45] Laptop interventions delivered in emergency room settings help high-risk youth think more about their alcohol use, require little assistance to operate, and are rated favorably among youth.[46] Compared to giving risky alcohol-using youth a brochure to review, computer-based interventions that utilize therapeutic constructs such as personalized normative feedback (PNF), improve perceptions concerning the importance of cutting down on alcohol use as well as the likelihood they will actually do so.[44]

## University Setting

Colleges and universities struggle with identifying and managing risky alcohol use among students.[47] Universities typically provide alcohol counseling to a student after an alcohol-related incident[47] (i.e. "mandated" students). Universities also deliver preventative interventions to large groups of non-mandated students (e.g. freshman orientation or student health center) by screening the whole student population, identifying heavy drinking students, and then providing an intervention to the heavy drinking students. Technology-based interventions can effectively serve both of these needs. These interventions address the

needs of students across the spectrum of alcohol use severity[48] and provide immediate access to different types of content related to alcohol use.[49] They use a mix of education, skill development, motivational techniques, and personalized normative feedback.[49]

**Personalized Normative Feedback and Technology (PNF)—**Personalized normative feedback is a crucial component of any technology-based intervention aimed at reducing college students' alcohol use and related negative consequences.[50,51] College students often use alcohol heavily and have skewed perceptions of alcohol use norms and risk.[52] PNF delivered via computer, changes student perceptions of norms as well as their alcohol use by providing corrective information about normative drinking among peers.[53]

There are a variety of PNF-based interventions that effectively address alcohol use among students. For example, compared to education-based interventions, checkyourdrinking.net reduces mandated students' amount and frequency of alcohol use as well as estimates of alcohol use among peers.[54] It does this by providing summary information about a student's drinking habits and helps the student visually compare (via graphs) their habits with normative drinking patterns among their peers. This effectiveness also translates to screening and brief interventions for non-mandated student populations which are easy to implement, appeal to youth, and reduce risky drinking compared to educational controls.[55] Compared to assessment-only controls the College Drinkers Check-Up (CDCU) reduces drinking among high-risk college students up to one year after the intervention.[56] CDCU is web-based and contains brief motivational techniques and PNF based modules such as the "Get Feedback module" (normative behavior feedback).[56] The Electronic CHECKUP TO GO (e-CHUG) intervention also incorporates personalized feedback and has been evaluated in multiple randomized controlled trials for high-risk drinkers. e-CHUG lowers weekly alcohol consumption and psychosocial consequences related to their alcohol use.[51] e-CHUG also reduces university sanctions among incoming freshmen with risky drinking behaviors.[57]

**Other Drugs in University Settings—**Technology-based interventions in college settings have also been used for substances other than alcohol. Technology-based interventions increase the rate of tobacco abstinence by close to 50%.[58] Few studies however have evaluated technology-based interventions focused on marijuana among college students.[58] Technology-based interventions can be geared towards changing perceptions of marijuana use norms. For example, the web-based Marijuana E-Checkup (E-Toke) intervention helps students weigh pros and cons of marijuana use and uses PNF to correct beliefs about marijuana use norms.[59]

## Technology-Based Treatment

The scientific community has made significant progress developing and testing different psychotherapies for youth with substance use disorders. However, while treatment mitigates psychological,[60] medical,[61] and legal problems[60] associated with substance use, our current models for delivering that treatment are fraught with problems.[11,14] Few treatment facilities offer adolescent-specific programs[15] and only 10–15% of youth who may benefit from treatment actually receive it.[14] Community-based treatment programs with limited finances, staff, and resources, struggle to provide evidenced-based treatment in the context of shifting

payment and reimbursement models.[11,62] While treatment reduces substance use,[63] the effects typically diminish after 3 to 6 months.[63] Youth who complete treatment struggle to maintain sobriety on their own and thus post-treatment therapeutic support is critical.[14] For a more comprehensive discussion of this topic, refer to the article in this issue titled, "Co-occurring Psychiatric and Substance Use Disorders".

It is important to note that the Institute of Medicine report used to generate the intervention categories in this article (universal, selected, treatment) emphasized a distinction between "indicated prevention" and "treatment". Specifically, interventions that focus on individuals with a *specific diagnosed disorder* are deemed "treatment" rather than indicated prevention.[64]

Technology-based interventions are cost-effective,[65] adhere to evidence-based psychotherapeutic principles such as motivational interviewing, cognitive behavioral paradigms[23] or community reinforcement approaches.[66,67] They provide effective post-treatment support,[68] and are effective in treating adults with substance use disorders[65] as stand-alone[66], partial replacement[69] and clinician extender interventions.[70] These interventions are commonly implemented via a computer or mobile phone. However, few studies have explored the use of technology-based interventions for treating youth with substance use disorders. Attitude and focus group data suggest that youth in treatment view these technologies (particularly mobile phone texting) as potentially useful components of treatment and post-treatment relapse prevention treatment.[71–73]

**TES—**The Therapeutic Education System (TES) is a web-based intervention. It is an interactive program designed to help individuals with substance use disorders develop skills emphasized in cognitive-behavioral therapy and relapse prevention training. TES contains HIV-related modules that have been shown, in two randomized clinical trials, to be an effective in HIV prevention among youth with substance use disorders.[74,75]

**Step Up—**The web-based Step Up intervention is comprised of 21 modules completed over 12 sessions. It is designed to help users develop assertiveness and communication skills and is based on the Adolescent Community Reinforcement Approach.[76] Users complete modules at their own pace, and receive tailored content based on their responses. Step Up was recently evaluated in a randomized controlled trial. Youth (12–18) entering a substance use treatment program were randomized to standard treatment or standard treatment with parts replaced by Step Up. Results demonstrated that replacing components of standard treatment with Step Up allows youth to achieve similar reductions in substance use and mental health outcomes compared to treatment as usual. Additionally, Step Up was rated as highly acceptable to youth.[77]

### Identifying Therapeutic Opportunities: Ecological Momentary Assessment (EMA)—

EMA "…involves repeated sampling of subjects' current behaviors and experiences in real time, in subjects' natural environments".[78] Mobile phone-based EMA provides the ability to collect real-time data and obtain an accurate profile of the temporal relationship between behaviors and outcomes. It allows us to identify where, when, and why youth are most vulnerable and develop interventions that target these windows of

vulnerability.[79] In terms of clinical applications, the EMA paradigm is well suited to serve in a "clinician extender" capacity that can augment treatment in two potential ways. First, it can serve to inform functional analysis (e.g. identifying different emotional or peer influence triggers) that therapists may use in the context of cognitive behavioral therapy. Second, it can address the poor, post-treatment relapse rates common among youth with substance use disorders.[14,63,80,81] To date, a handful of studies have evaluated treatment for youth with substance use disorders using EMA data, all with promising results.

**ESQYIR—**ESQYIR (Educating & Supporting Inquisitive Youth in Recovery) is an EMA program that uses mobile phone technology to help youth maintain sobriety after leaving treatment. ESQYIR's text message content and delivery schedule are programmed based on focus group data from youth in substance use treatment programs.[72] ESQYIR provides two daily text messages (e.g. self-monitoring and recovery tips) as well as social support resource information on weekends.[68] ESQYIR titrates content of text messages based on real-time feedback provided by youth. For example, youth receive monitoring questions to assess current challenges (e.g. mood issues). Youth then provide a numeric response indicating the severity of the problem. Based on this information, youth are classified under a risk of relapse category and specific text message content (previously vetted and matched to this level of severity) is sent.[68]

In a pilot study, individuals were randomly assigned to receive ESQYIR or aftercare as usual (i.e., two monthly phone calls for recovery monitoring). Youth who received ESQYIR were half as likely to relapse as those who received treatment as usual during the 12-week study period and at the 3-month follow-up. Youth who use ESQYIR also have less severe problems related to substance use, and demonstrate active participation in their recovery (i.e., attendance in recovery groups).[68] Notably, youth who participate in this intervention are significantly less likely to be positive for substances at 6- and 9-month follow-up assessments.[82]

**MOMENT—**The Momentary Self-Monitoring and Feedback Motivational Enhancement (MOMENT) intervention is another EMA intervention that utilizes mobile technology to intervene with cannabis-using youth. Youth first meet with counselors for two brief motivational interviewing sessions to discuss their top three triggers for using cannabis. Over the next two weeks, youth report their triggers, cravings, and actual cannabis use with their mobile phone. Participants receive text messages to help them cope with the previously identified triggers. Researchers have demonstrated that MOMENT can be successfully implemented in treatment settings and is acceptable to youth. Preliminary effectiveness data suggest that using MOMENT lowers frequency of marijuana use compared to baseline levels of use.[83]

## Conclusions and Future Directions

Technology-based interventions offer us the ability to rapidly expand access and availability of evidence-based preventative and treatment interventions for youth. These interventions have the potential to address gaps in existing clinical services such as recovery support

services or continuing care. They offer a variety of advantages over traditional interventions and may be used as an adjunct to traditional interventions or as stand-alone interventions.

Across universal prevention, selective prevention, and treatment interventions, technology-based solutions are not only effective, but also remedy many implementation problems associated with traditional interventions, including an insufficient workforce to deliver evidence-based interventions, time constraints for delivering evidence-based interventions in many systems of care, and cost of person-delivered interventions. Technology allows one to tailor interventions to different subgroups, adapt content in real time, and facilitate rapid dissemination to large groups with minimal effort. Technology also allows for anytime/anywhere access to evidence-based therapeutic support in a wide array of settings. And, as the temporal trends in various substance preferences among youth shift in new directions, may utilize technology-based interventions to respond quickly and effectively to provide a scalable response.

One promising and currently under-utilized potential new direction in addressing substance use among youth is social media. About 95% of 12–17-year-olds use the Internet, and 81% use social networks.[84] Popular sites among youth include Instagram Twitter, Snapchat, Facebook, Tumblr, Google+, and Pinterest.[85] Given the ubiquity of social media use among youth, the opportunities to harness social media for delivering preventative and therapeutic interventions to a large end user base are substantial and under-tapped. Social media offers the potential to provide new avenues for delivering individual or group-based preventative and treatment interventions that have yet to be explored scientifically.

Overall, the research literature to date, although limited, underscores the promise of utilizing technology in the prevention and treatment of substance use disorders among youth. Technology-based interventions may serve as important tools to reach youth at a population level. As the scientific community learns more about mechanisms of therapeutic change and how to translate them into digital formats, technology's influence and clinical applications in addressing substance use among adolescents will become more prolific.

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**Key Points**

- Technology-based interventions are effective for preventing and treating substance use disorders.
- Technology is particularly suited to youth.
- Technology-based interventions are relevant at any stage in the development of a substance use disorder.
- Technology-based interventions provide solutions to extant problems of traditional interventions.

## Table 1

| Appendix: Technology-based Primary, Secondary, and Treatment Interventions | |
|---|---|
| **Primary Prevention:** | |
| CLIMATE: | http://www.climateschools.com/ |
| Head On: | http://www.preventionsciencemedia.com |
| Thinking Not Drinking: | http://www.childtrends.org/?programs=thinking-not-drinking |
| RealTeen: | http://socialwork.columbia.edu/research/research-scientists/traci-schwinn |
| Refuse to Use: | http://www.orcasinc.com/ |
| **Secondary Prevention:** | |
| Alcohol 101+: | http://responsibility.org/college-students-and-drinking/alcohol-101/ |
| Alcohol Edu: | https://everfi.com/higher-education/alcoholedu/ |
| Check Your Drinking: | http://www.checkyourdrinking.net |
| CDCU: | http://www.collegedrinkerscheckup.com/ |
| E-CHUG: | http://www.echeckuptogo.com/usa/programs/coll_alcohol.php |
| E-TOKE: | http://www.echeckuptogo.com/usa/programs/coll_mj.php |
| THRIVE: | http://lamp.health.curtin.edu.au/thrive/baselinetest.php |
| **Treatment:** | |
| ARISE: | http://www.liebertonline.com/g4h |
| MicroCog: | http://www.pearsonclinical.com/ |
| MOMENT (presentation): | http://www.nattc.org/userfiles/file/Shrier_L(1).pdf |
| TES: | http://www.sudtech.org |