Community Preventive Services Task Force

Substance Use: Digital Interventions to Prevent Substance Use among Adolescents

Community Preventive Services Task Force
Finding and Rationale Statement
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CPSTF Finding and Rationale Statement

Context

Youth substance use is associated with increased risk for behavioral and academic problems, teen pregnancy, sexually transmitted infections, being involved in or experiencing violence, injuries, and mental health symptoms (such as anxiety and depression) (U.S. Department of Health and Human Services 2016). Preventing or delaying substance use initiation among youth (defined in this review as adolescents ages 10-17 years) reduces later risk for substance use, substance use disorders, and overdose (U.S. Department of Health and Human Services 2016).

Substance use trends in the United States have changed in recent years. There have been increases in illegally-made fentanyl and the availability of other synthetic opioids, misuse of prescription drugs, popularity of e-cigarettes and vaping products, and changes in the legal and regulatory landscape for cannabis (Hoots et al. 2023).

In 2023, patterns of substance use among adolescents varied by grade level and demographic characteristics. Approximately 22% of teens reported current use of alcohol, 17% marijuana, and 4% misuse of prescription opioids (CDC 2024). Three percent of 12th graders reported use of cigarettes and 22% reported vaping within the last 30 days (Miech el al. 2024). Rates of alcohol consumption increased from about 6% in eighth grade to nearly 24% by twelfth grade (Miech et al. 2024). Initiation rates for prescription opioid misuse were higher among females and those identifying as multiracial or "lesbian, gay, bisexual, questioning, or another non-heterosexual identity" (LGBQ+) (CDC 2024).

Prevention interventions delivered through digital devices have the potential to reduce barriers to accessing health promotion resources among adolescents (Rideout & Fox 2018; Villanti et al. 2017). Access to digital devices is widespread among teens, with 95% reporting they own smartphones and 90% having computers at home. Access rates were similar across sexes and racial/ethnic groups (Pew Research Center 2022). Digital interventions can be designed to reduce barriers to engagement by offering anonymity and a non-judgmental environment that may reduce stigma (Taylor & Luce 2003; Johansson et al. 2024; Monarque et al. 2023).

When focused on substance use by adolescents, intervention prevention goals include reducing the initiation, prevalence, and frequency of use (U.S. Department of Health and Human Services 2016). Measures of change in each of these prevention outcomes can be influenced by the substances evaluated, the age of adolescents at baseline and follow-up, and background rates of initiation and use.

Intervention Definition

Digital interventions for substance use prevention deliver information, behavioral instruction, or support to adolescents to reduce the uptake and use of one or more substances. Intervention content must be accessible through a computer, tablet, or smartphone and may be provided as web-based programs, computer or tablet

programs, smartphone applications, text messages, online forums, or a combination of formats. Interventions may provide general prevention content or focus on specific substances (such as alcohol, tobacco, or cannabis). Content may be tailored or interactive (i.e., adolescents enter personal data or make choices and receive feedback) and provided in a single interaction, over multiple modules or sessions, or as an ongoing resource. Interventions may be delivered to adolescents directly, at school, at home, or through community settings. Digital interventions may be complemented by additional activities such as screening for substance use, brief interpersonal counseling, and classroom-based instruction or discussion sessions.

Community Preventive Services Task Force Finding (December 2024)

The Community Preventive Services Task Force (CPSTF) recommends digital interventions for substance use prevention based on sufficient evidence of effectiveness in reducing current or past month alcohol use, and binge drinking. Digital interventions also reduced the frequency of cannabis use, tobacco including electronic cigarette use, and prescription drug misuse among adolescents. Evaluated interventions showed inconsistent effects on reported rates of initiation for all substances and current use for substances other than alcohol. Additional studies are needed to determine the effectiveness of digital interventions for these outcomes.

Rationale

Basis of Finding

The CPSTF recommendation is based on evidence from a systematic review of 45 studies, 20 of which were conducted in the United States (search period from January 2000 to July 2023).

The systematic review team evaluated substance use measures reported in the included studies for the following outcome categories:

1) Use (prevalence, amount, or frequency) of one or more substances (40 studies)
2) Initiation of use for one or more substances (16 studies)

Studies included a median of 1,234 participants (IQI: 543 to 2,134 participants; 45 studies). The median duration of intervention activities was 1.5 months (in 10 studies intervention content was provided in a single session). Most interventions provided multiple sessions or modules (median: 6 sessions, 4.5 hours), The median study evaluation period was 12 months (IQI: 6.0 months, 24.0 months; 45 studies).

Studies used a variety of self-reported measures for substance use outcomes primarily collected through school-based surveys of students. Substance use was typically measured as prevalence or frequency of use in the previous 30 days. Prevalence measures indicated current or recent use of one or more substances. Frequency measures indicated the number of times or episodes of using one or more substances; these measures were often categorized or summed into scale scores. Initiation of substance use was commonly measured based on self-reported lifetime (ever) use.

For both initiation and substance use, the review team generated assessments for each substance type (i.e., alcohol, binge drinking of alcohol, cannabis, tobacco, illicit substances as defined by the study, prescription drug misuse, and combined substance measures as defined by the study). As study data permitted, absolute or relative change measures were calculated, and summary effect estimates were generated. For study outcomes that could not be converted into absolute or relative change estimates, study results were summarized and grouped for a narrative assessment based on the direction of effect and statistical significance.

CPSTF findings are based on both summary effect estimates and narrative assessments for each outcome category and substance type. Evidence showed digital interventions led to meaningful reductions in the prevalence of alcohol use and binge drinking, frequency of alcohol, cannabis, and tobacco use, and frequency of prescription drug misuse (Table 1). Findings for initiation, regardless of substance type, were inconsistent (Table 2).

Table 1. Effects of Interventions on Substance Use Prevalence and Frequency

Substance	Measure	Absolute Change (percentage points) Median estimate (IQI); Number of Studies	Relative Change (%) Median estimate (IQI); Number of Studies	Narrative Results Direction and statistical significance of estimates	Overall Direction of intervention effect
Alcohol	Prevalence of use	-3.55 (-8.43, 2.30); 8 studies	-22.2% (-38.4%, -8.4%); 8 studies	NA	Favors the intervention
	Frequency of use	NA	-22.9% (IQI: -49.7%, 25.8%); 13 studies	1 significant and favorable, 4 favorable, 7 no change	Favors the intervention
	Binge drinking	-1.40 (-4.90, 2.83); 11 studies	-16.8% (-30.5%, 4.9%); 11 studies	3 significant and favorable, 6 favorable, 3 no change	Favors the intervention
Cannabis	Prevalence of use	0.65 (-2.73, 1.40); 6 studies	7.1% (-28.4%, 16.8%); 6 studies	NA	No effect
	Frequency of use	NA	-46.3% (-97.8%, -16.0%); 10 studies	2 significant and favorable, 2 favorable, 2 no change	Favors the intervention
Tobacco	Prevalence of use	-1.59 (-3.98, 5.13); 6 studies	-12.8% (-42.9%, 14.9%); 6 studies	1 no change	Inconsistent results

	Frequency of use	NA	-38.8% (-90.6%, -7.9%); 9 studies	2 favorable and significant, 1 favorable, 1 no change, 1 unfavorable	Favors the intervention
Illicit substances	Prevalence of use	NA	NA	NA	NA
	Frequency of use	NA	NA	2 significant and favorable, 1 favorable, 2 no change	Inconsistent results
Prescription drug misuse	Prevalence of use	NA	NA	NA	NA
	Frequency of use	-0.14 episodes (-2.89 , -0.05 episodes); 4 studies	-127.1% (-622.3%, -63.6%), 4 studies	1 no effect	Favors the intervention
Combined measures#	Prevalence of use	1.70 (Range: 1.10, 3.90); 2 studies	25.2% (Range 4.4%, 61.1%); 3 studies	1 favorable and significant, 1 no change	Inconsistent results
	Frequency of use	NA	NA	6 favorable and significant, 2 favorable, 2 no change	Favors the intervention

IQI: Interquartile Interval

#Findings from studies that measured self-reported use or frequency of one or more substances selected from a list (for example, "use of one or more illegal drugs such as marijuana, cocaine, amphetamines, methamphetamines, barbiturates, inhalants, opioids, etc.").

NA: Not applicable

Table 2. Effects of Interventions on the Initiation of Substance Use

Substance	Measure	Absolute Change (percentage points) Median estimate (IQI); Number of Studies	Relative Change (%) Median estimate (IQI); Number of Studies	Narrative Results Direction and statistical significance of estimates	Overall Direction of intervention effect
Alcohol	Initiation	+0.85 percentage points (IQI: -4.98, 5.03); 3 studies	Relative: -1.8% (IQI: -18.1%, 5.5%); 4 studies	1 favorable, 1 unfavorable and significant	Inconsistent results
Cannabis	Initiation	+1.40 percentage points (IQI: -3.68, 2.92); 4 studies	+8.9% (IQI: -20.2%, 121.7%); 4 studies	1 favorable	Inconsistent results

Tobacco	Initiation	-0.05 percentage points (-2.30, 1.20); 5 studies	+1.04% (IQI: -24.8%, 7.2%); 5 studies	1 significant and favorable, 3 favorable, 1 no change, 1 unfavorable 1 unfavorable and significant	Inconsistent results
Illicit substances	Initiation	NA	NA	5 no change	No effect
Prescription drug misuse	Initiation	NA	NA	NA	NA
Combined measures[#]	Initiation	NA	NA	NA	NA

IQI: Interquartile Interval
#Findings from studies that measured self-reported initiation of use of one or more substances selected from a list (for example, "use of one or more illegal drugs such as marijuana, cocaine, amphetamines, methamphetamines, barbiturates, inhalants, opioids, etc.")
NA: Not applicable

CPSTF judged the effect sizes were consistent and meaningful for:

- reductions in the prevalence of alcohol use, and binge drinking.
- reductions in the frequency of use for alcohol, binge or heavy drinking, cannabis, tobacco use and prescription drug misuse.

No studies evaluated effects on the prevalence of illicit substance use, and studies that examined changes in the frequency reported effects that were inconsistent. Two studies showed a reduction in the frequency of e-cigarette use with one study reporting significance.

Table 3 reports all other outcomes. Results were in the favorable direction for reducing anxiety symptoms, perceived stress, and alcohol-related harms and consequences but the use of different measures (i.e., scale scores) across studies for these outcomes and uncertainty about their meaningfulness prevented a determination on effectiveness. Results were inconsistent for outcomes measuring the development of substance use disorders, and reducing symptoms of depression and other symptoms related to mental health. The intervention showed no effect on reducing harms or consequences related to cannabis use. There were not enough studies for the outcomes on quality of life, sexual risk behaviors, truancy, and anti-social behaviors (i.e., alcohol-related troubles and delinquency).

Table 3. Effects of Interventions on Morbidity, Mental Health Symptoms, Risk Behaviors, and School-related Outcomes

Outcome	Number of Studies (Estimates)	Narrative Evidence	Overall Direction of Effect

		Direction and Reported Statistical Significance of Study Outcomes	
Anxiety symptoms	3 (6 estimates)	1 significant and favorable, 3 favorable, 2 no change	Favors the intervention
Perceived stress	3 (3 estimates)	3 significant and favorable	Favors the intervention
Alcohol-related harms and consequences	5 (6 estimates)	3 significant and favorable, 1 favorable, 2 no change	Favors the intervention
Development of substance use disorders	3 (8 estimates)	1 significant and favorable, 1 favorable, 3 no effect, 3 unfavorable	Inconsistent Results
Depression symptoms	4 (7 estimates)	3 favorable, 4 no change	Inconsistent Results
Other symptoms related to mental health	3 (5 estimates)	2 significant and favorable, 3 no change	Inconsistent Results
Cannabis-related harms and consequences	3 (5 estimates)	1 favorable, 4 no change	No effect
Quality of life or well-being	2 (2 estimates)	1 signficiant and favorable 1 no change	Too few studies
Sexual risk behaviors	2 (3 estimates)	1 significant and favorable, 1 favorable, 1 no effect	Too few studies
Truancy	1 (1 estimate)	1 significant and favorable	Too few studies
Anti-social behaviors: Alcohol-related troubles	1 (1 estimate)	1 significant and favorable	Too few studies
Anti-social behaviors: Delinquency	1 (1 estimate)	1 favorable	Too few studies

Applicability and Generalizability Issues

Intervention Settings

The CPSTF finding is applicable to the use of digital interventions implemented in school, clinic, home, and online settings in the United States. Setting of intervention varied across the 45 studies with nine studies taking place in schools, five studies online, three studies in clinics, and one study in a home/family setting; no studies

implemented interventions in community locations alone. Interventions in 15 studies were delivered in both schools and online, and 13 studies involved a mix of locations other than school or online. Overall, effects were similar across evaluated implementation settings. Twenty studies were conducted in the United States, with findings from this subset indicating effectiveness.

Most studies did not identify whether the intervention was implemented in rural, suburban, or urban communities. Of studies that reported this information, 11 took place in urban or suburban areas and one took place in a rural setting; six studies were in a mix of urban, suburban, and rural areas. The intervention is applicable to urban and suburban areas, and likely applicable to rural areas, though more evidence for rural areas is needed.

Population Characteristics

The CPSTF finding is applicable to digital interventions provided to adolescents (ages 10-17 years at the time of intervention). The median age of study youth at baseline was 14.2 years (38 studies). Studies evaluated adolescents in middle school (n=13), high school (n=21) and combined levels (n=11). Findings are applicable to males and females as sex was evenly distributed across the studies. Three studies stratified effectiveness by sex and results were inconsistent. Only one study collected information on adolescents who identify as a sexual minority.

The CPSTF finding is applicable to White, Black or African American, and Hispanic or Latino adolescents. None of the individual studies compared results by race/ethnicity, but several racial/ethnic populations were represented among participants. Among the 20 studies conducted in the United States, participants identified as White (median 64%; 15 studies), Black or African American (median 17%; 17 studies), Hispanic or Latino (14%; 18 studies), Asian (5%; 11 studies) American Indian (2%, six studies), or other (8%, 12 studies). More research on effectiveness is needed for American Indian and Alaskan Native, Native Hawaiian and Pacific Islander, and Asian adolescents. More evidence is needed to determine effectiveness based on household socioeconomic status. Only two studies provided data on free (14%), or reduced cost (38%) lunch program participation. Five studies reported parents' education level with a median of 51% of parents reporting some college or more but results could not be analyzed across studies. More complete reporting of participant and household demographic characteristics would help address important evidence gaps.

Intervention Characteristics

The CPSTF finding is applicable to digital interventions providing general substance use prevention content (19 studies) or focused on a specific substance (23 studies). Digital interventions were effective when implemented alone (34 study arms), or when combined with additional non-digital interventions (15 study arms). Interventions were effective when provided through school (26 studies) or without school involvement (19 studies).

There was similar evidence of effectiveness for interventions providing tailored content (38 studies) and interventions that did not provide content tailored to adolescents (7 studies). Interventions lasting 1 month or longer (29 studies) were effective. Evidence on effectiveness was less consistent for interventions lasting less than 1 month (10 studies). Similarly, evidence of effectiveness was less consistent for interventions providing a single session or module (10 studies) compared to interventions providing multiple sessions or modules (median: 6 sessions; 34 studies). More evidence is needed to determine whether short duration or single session interventions are effective.

Data Quality Issues

There are several important limitations in the studies included in this review. Study designs used to evaluate digital interventions included both individual (16 studies) and group randomized trials (29 studies). Despite randomization, studies frequently identified differences in participant characteristics between intervention and comparison groups at baseline. Important demographic characteristics were infrequently reported for participating parents and caregivers (e.g., income, education), which limited stratified assessments on effectiveness for these factors. Participant attrition was a common limitation; the median retention rate at follow-up was 74.9% (IQI: 65.6%, 82.5%).

Studies differed in substances and risk behavior outcomes, the measures used to evaluate change, and the reporting of results. These issues limited the review team's ability to compare study findings, consolidate effect estimates, and calculate summary effect estimates for the outcomes of interest. Almost all outcomes were based on self-reported substance use and other risk behaviors among participating youth, which introduced potential bias in these measures.

Potential Benefits

CPSTF did not postulate any additional potential benefits of digital interventions to prevent substance use among adolescents. Two of the included studies in this review reported additional benefits. Adolescents in one study perceived that drug use among peers decreased (Schwinn et al. 2019). A second study documented a decrease in self-reported alcohol consumption by mothers participating in the study with their adolescent children (Schinke et al. 2009). No additional benefits were described or evaluated in the broader literature.

Potential Harms

CPSTF did not postulate any potential harms of digital interventions to prevent substance use among adolescents. Some studies in this review evaluated potential harms associated with digital interventions. Two studies incorporated systems to monitor adverse events, yet reported no identified harms (Champion et al. 2023, Griffin et al. 2022). Authors in two studies discussed the possibility that intervention content could inadvertently encourage substance use behaviors among some adolescents (Malmberg et al. 2015, Bannink et al. 2014). One study determined that some participants experienced discomfort from information about riding with an impaired driver (Knight et al. 2019). No harms were identified in the broader literature.

Considerations for Implementation

The following considerations for implementation are drawn from studies included in the existing evidence review, the broader literature, and expert opinion, as noted below.

Programs implemented within schools often encounter logistical challenges. These include constraints on available time for program delivery (Griffin et al. 2022), competing academic demands, and limited access to resources such as computer labs (Buller et al. 2008, Champion et al. 2018, Vogl et al. 2014).

None of the included studies addressed the increasing influence of social media on adolescents (U.S. Department of Health and Human Services 2023). Given the rapidly evolving nature of social media platforms and digital communication, this represents a significant gap in current research. Messages promoting substance use are commonly posted on social media (Rutherford et al. 2023), making this an important subject for parent communication and monitoring skills and practices. Future interventions may also want to use social media to promote prevention messaging (Evans et al. 2020).

Family-based interventions were implemented in 12 of the 45 included studies. CPSTF recommends family-based interventions that provide instruction or training to parents and caregivers to enhance substance use preventive skills and practices for children and adolescents.

CPSTF also recommends intervention approaches related to the following:

- Preventing Excessive Alcohol Use | The Community Guide
- Reducing Tobacco Use | The Community Guide

Implementation Resources

Several organizations offer implementation guidance for supporting digital interventions and for specific interventions to address substance use:

- Program Reviews | The Center for Technology and Behavioral Health (c4tbh.org), a registry synthesizing current research on digital health technologies for substance use disorders and co-occurring conditions.
- Blueprints Programs | Blueprints for Healthy Youth Development, a registry of scientifically rigorous and accessible prevention and intervention programs aimed at addressing youth health and behavior issues
- Voices of Youth, Substance Use Prevention Resources for Youth and College Students | SAMHSA, contains resources for Middle School Youth (Ages 10–13) and High School Youth (Ages 14–18)
- Talk. They Hear You. Campaign | SAMHSA — a comprehensive campaign, including digital interventions, aims to reduce underage drinking and substance use among youths under the age of 21 by providing parents and caregivers, educators, and community members with resources to discuss substance use with their children.
- Operation Prevention | DEA, in partnership with Discovery Education provides digital lesson plans, virtual field trips, parent resources, and an interactive drug facts challenge.

- Teen-Safe, an online resource offering tips for preventing teen prescription drug abuse; it's part of a broader initiative aimed at safe medication practices across all ages.

Specific Model Resources:

- eCHECKUP TO GO, a suite of interactive online tools designed to encourage healthier choices regarding alcohol, marijuana, and other substances relevant for older adolescents.
- Smokefree Teen | National Cancer Institute, aimed at helping teens quit smoking. It offers resources including text message programs, apps, and an online guide.

Evidence Gaps

CPSTF identified several areas that have limited information. Additional research and evaluation could help answer the following questions and fill remaining gaps in the evidence base.

CPSTF identified the following questions as priorities for research and evaluation:

- How effective are interventions in reducing the number of adolescents who report the initiation or current use of one or more substances?
- How effective are interventions for American Indian, Alaskan Native, Native Hawaiian, Pacific Islander, and Asian adolescents and for adolescents who identify as a sexual minority?
- How effective are interventions in rural communities, or when provided to individuals with lower household incomes or family educational attainment?

Remaining questions for research and evaluation identified in this review include the following:

- How effective are interventions in reducing development of substance use disorders?
- How effective are interventions in improving outcomes related to substance use including mental health symptoms, educational outcomes such as attendance and attainment, sexual risk behaviors, and encounters with the criminal justice system?
- How effective are interventions in reducing initiation and use of illegal substances among adolescents?
- How effective are interventions in reducing polysubstance use among adolescents?
- How effective are digital interventions when delivered in community-based settings?
- How effective are interventions among adolescents with a disability?
- Which characteristics of digital interventions are associated with meaningful and consistent effects on initiation use, or frequency of use of substances?

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