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Examining the relationship between digital media and substance use: a study using ecological momentary assessment in youth

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ARAM V. CHOBANIAN & EDWARD AVEDISIAN SCHOOL OF MEDICINE

Thesis

**EXAMINING THE RELATIONSHIP BETWEEN DIGITAL MEDIA AND
SUBSTANCE USE: A STUDY USING ECOLOGICAL MOMENTARY
ASSESSMENT IN YOUTH**

by

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B.A., Boston University, 2020

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DEDICATION

I would like to dedicate this work to my mom. Without all her love I would not be the person I am today.

ACKNOWLEDGMENTS

I would like to sincerely thank everyone who helped me to write this thesis. My principal investigator, Dr. Gansner, for allowing me to help her with this research and all of her assistance and mentorship. My advisor, Dr. Bragdon, Dr. Offner and the librarians for all of their help writing and formatting my thesis. My family, partner, and friends for their unwavering confidence in me, love and support. And to my little brother and the kids at HH for introducing me to the concept of Problematic Internet Use.

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ABSTRACT

Background: Adolescents exposed to substance-related content online appear to have higher rates of substance use; youth with a history of Problematic Internet Use (PIU) also may be more likely to struggle with substance use. There is limited data examining what types of digital media may be more significantly associated with use of substances, or whether youth with active PIU symptoms are more likely to use substances. This study used smartphone-based ecological momentary assessment to gather pilot data on potentially relevant relationships between PIU, digital media exposures, and substance use.

Methods: Youth aged 13-23 were recruited from outpatient mental health clinics at Cambridge Health Alliance. Participants used the app MindLamp for 6 weeks to record daily substance use, online exposures to drug-related content, PIU (via the PIU-SF-6 screen), and most frequently used apps or websites that day. Digital media content was extracted from daily iPhone screen time reports. Multilevel mixed effects regression models were used to analyze data, controlling for random effects at the level of the participant.

Results: The pilot study recruited 26 participants (61.5% female, mean age 15.96). There was a significant positive correlation between PIU score and the active urge to use substances; however, controlling for urge to use substances and online substance-related exposures, PIU scores were significantly lower on days with reported substance use. Days with frequent use of direct messaging social media platforms were associated with greater risk for both exposure to substance-related content online and substance use. Substance use was specifically linked to viewing social media posts where peers had disclosed their own substance use.

Conclusion: Use of social media platforms that allow for direct messaging appear to be associated with a greater risk of both exposure to substance-related content and substance use. Our data also suggest that excessive Internet use may actually represent a coping skill to avoid engagement in substance use. More highly powered longitudinal studies are needed to confirm and expand upon our findings.

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LIST OF ABBREVIATIONS

CDC	Centers for Disease Control and Prevention
CHA	Cambridge Health Alliance
CIUS	Compulsive Internet Use Score
CRAFFT	Car, Relax, Alone, Forget, Friends, Trouble
DAST-A	Drug Abuse Screening Tool for Adolescents
DSM	Diagnostic and Statistical Manual
EMA	Ecological Momentary Assessment
GAD-7	General Anxiety Disorder-7
GPS	Global Positioning System
NM-ASSIST	National Institute on Drug Abuse Modified Alcohol, Smoking and Substance Involvement Screening Test
PHQ-8	Patient Health Questionnaire-8
PIU	Problematic Internet Use
PIUQ	Problematic Internet Use Questionnaire
PIUQ-SF-6	Problematic Internet Use Questionnaire Short Form -6
SUD	Substance Use Disorder

INTRODUCTION

Adolescent Digital Media Use

As of 2021, teenagers in the United States were estimated to spend an average of over eight and half hours using digital media each day, not including time spent on online homework or school work (Rideout, et al., 2022). This estimate increased from 2019, when adolescents were estimated to spend only seven hours and twenty two minutes using digital media each day (Rideout & Robb, 2019). This documented increase in digital media use is likely partially attributable to the rise in personal smartphone ownership in adolescents, with 88% of U.S. teenagers owning one (Rideout, et al., 2022). It is also likely influenced by the COVID-19 pandemic, as digital media use for non-school purposes rose 17% over two years (2019-2021) as compared to only 11% over four years (2015-2019) (Rideout, et al., 2022). The specific type of digital media consumption can vary widely among youth, including activities such as streaming or watching videos online, posting or scrolling on social media, shopping, “surfing” the Internet, listening to music, and gaming. The most popular online activity for adolescents is watching videos, with 77% of teens stating they watch online videos “daily” (Rideout, et al., 2022). The next most popular online activity is using social media. These are followed by web browsing, then mobile phone gaming, then playing video games (Rideout, et al., 2022).

Adolescent digital media use varies across sex, economic status, and race/ethnicity. Adolescent boys spend more time using digital media than adolescent girls; with boys averaging nine hours and sixteen minutes each day and girls averaging

eight hours and two minutes each day (Rideout, et al., 2022). The type of digital media use varies as well, with adolescent boys being more likely to use YouTube, Twitch and Reddit than their female counterparts and adolescent girls being more likely to use TikTok, Instagram and SnapChat than their male counterparts (Pew Research Center, 2022). Adolescents in middle-income households spend the most time using digital media on average, nine hours and thirty-four minutes each day, compared to nine hours and nineteen minutes each day for adolescents in low income households, and seven hours and sixteen minutes each day for adolescents in high income households (Rideout, et al., 2022). Hispanic/Latino adolescents spend an average of ten hours and two minutes each day using digital media, whereas Black adolescents spend an average of nine hours and fifty minutes each day, and white adolescents spend an average of seven hours and forty-nine minutes each day (Rideout, et al., 2022).

Problematic Internet Use

As the amount of time adolescents spend daily on screens increases, there has been growing concern about youth that may be unable to regulate personal use of screens and the Internet. Ninety-seven percent of U.S. teenagers report going online “daily” and forty-six percent report being online “almost constantly” (Pew Research Center, 2022). Problematic Internet Use (PIU), also known as Internet Addiction or Excessive Internet Use, is characterized by an individual’s inability to control their use of the Internet, causing negative consequences, such as distress or functional impairment (Spada, 2014). While PIU is not recognized in any formal diagnostic manuals, its variation Internet Gaming Disorder is listed in the appendix of the *Diagnostic and*

Statistical Manual of Mental Disorders (DSM) fifth edition as a disorder requiring further study (American Psychological Association, 2013). Part of the reason that PIU has not yet been recognized as an official diagnosis is because there is contention in the scientific community regarding its pathophysiology and, subsequently, the disorder's defining characteristics. Researchers have hypothesized that PIU shares features with both addictive disorders and non-substance impulse control disorders, such as pathological gambling (Young, 1998), leading to disagreement regarding what type of disorder PIU represents. Young et al. (1998) adapted the DSM-IV criteria for pathological gambling into criteria for Problematic Internet Use and Internet dependence based on the belief that PIU represented an impulse control disorder. Researchers who favor the "Impulse Control Disorder" pathophysiology of PIU argue against categorization of PIU as an "addiction" because Problematic Internet Use is polymorphic (Starcevic, 2012). Moreover, they do not consider the Internet itself to be a medium to which individuals can be addicted; for example, someone may be addicted to online gambling or gaming, rather than the Internet itself.

Researchers who categorize PIU more like a substance use disorder (SUD) do so because substance use and PIU appear to share a similar pathology. Similar structural differences in the brain have been seen in adolescents with PIU and adolescents with SUD. DeBellis et al. found diminished prefrontal cortex volume and prefrontal cortex white matter volume in adolescents with alcohol use disorder (De Bellis et al., 2005). Rutherford et al. found decreased prefrontal cortex volume and decreased prefrontal cortex gray matter volume in adolescents with alcohol use disorder (Rutherford, et al.,

2010). Reduced gray matter volume in the prefrontal cortex has also been found in adolescents with Internet addiction, or PIU, and is considered to be consistent with those prefrontal cortex structure abnormalities in adolescents with substance use disorder (Yuan et al., 2011). Altbäcker et al. (2016) also found similar structural abnormalities in females with SUD and females with excessive Internet use. These findings suggest PIU and SUD share a similar biological underpinning.

Due to the ongoing lack of agreement surrounding PIU's official diagnostic criteria, PIU measurements vary between studies. Commonly used measures to assess PIU include Young's diagnostic criteria, the Compulsive Internet Use Scale (CIUS), and the Problematic Internet Use Questionnaire (PIUQ). While Young's criteria and the CIUS are based upon categorization of PIU as an impulse control disorder, the PIUQ was developed based upon the three domains necessary for diagnosis of addiction. These domains are obsession: obsessive Internet use and withdrawal when unable to use the Internet; neglect: neglect of personal responsibilities and daily activities in order to use the Internet; and control: difficulty and or inability to control one's Internet use. The PIUQ is validated in both adults and adolescents, and in both online and paper formats (Koronczai et al., 2011), and a modified, shortened version of the PIUQ, the PIUQ-SF-6, has been validated as a PIU screening tool in adolescents (Demetrovics et al., 2015).

PIU and Psychiatric Comorbidities

Despite ongoing controversy surrounding PIU's diagnostic categorization, PIU has been associated with numerous psychiatric comorbidities. Researchers have found correlations between mobile phone use and depressive symptoms (Bickham et al., 2015),

and Problematic Internet Use and depressive and anxious symptoms, conduct problems, inattention/hyperactivity, difficulties with peers, and suicidality (Kaess et al., 2014).

Further, studies have shown structural and functional changes in the brain associated with excessive Internet use (Altbäcker et al., 2016, Kühn & Gallinat, 2015, Yuan et al., 2011).

Specifically, these structural changes have been identified in structural correlates of the brain reward system like the nucleus accumbens (Altbäcker et al., 2016). Gansner et al.

found that PIU was associated with increased suicidality, and aggressive and

developmental disorders in psychiatrically hospitalized youth (Gansner et al., 2019).

Relationships between Digital Media Use and PIU and Substance Use

While PIU has not been accepted as a “substance use disorder” or “addiction” in and of itself, there exist many studies highlighting positive correlations between PIU and use of drugs or alcohol (Ko, et al., 2008, Rucker, et al., 2015, Morioka, et al., 2017).

Substance use itself is common among U.S. adolescents (Center for Disease Control, 2019). An estimated 17.2% of U.S. adolescents used illicit substances at least once in the past year (Substance Abuse and Mental Health Services Administration,

2020). Substance use disorder is defined as an individual’s inability to control their use of legal or illegal substances with significant impairment to health and responsibilities

(Jahan & Burgess, 2022). The 2019 National Survey on Drug Use and Health found that

2.7% of U.S. adolescents met the criteria for a substance use disorder (SUD), 14.1% of

U.S. adolescents met the criteria for a mental health disorder, and 1.7% of U.S.

adolescents met the criteria for both a substance use disorder and a mental health disorder

(Substance Abuse and Mental Health Services Administration, 2020). Adolescents who

met the criteria for a mental health disorder in the past year were more likely to be illicit drug users, marijuana users, opioid misusers, binge alcohol drinkers, and cigarette smokers (Substance Abuse and Mental Health Services, 2020).

It is generally accepted that adolescents may be particularly vulnerable to engaging in substance use because their brains are still developing. Adolescents' limbic systems develop earlier than their prefrontal cortex such that ventral striatal activation is increased, with limited inhibitory control offered from the prefrontal cortex; thus, the adolescent's neurobiologic reward system is highly sensitive and impulses are also less easy to control, increasing their propensity for reward-seeking, high-risk behavior (Rutherford, et al., 2010). Adolescents are at higher risk to initiate substance use (Wagner & Anthony, 2002), and earlier onset of substance use is predictive of later drug abuse and alcohol dependence (Grant & Dawson, 1998). Adolescents' brains are also more vulnerable to the effects of substance use (Rutherford, et al., 2010).

Many researchers consider these neurobiologic vulnerabilities as a driving factor in the development of both PIU and SUD, in addition to citing the aforementioned neuroimaging studies that imply a shared neurobiology between the two. Furthermore, frequent Internet use might also influence substance use via other mechanisms. For example, research suggests that online exposures to drug and alcohol-related content may also influence engagement in subsequent substance use (Stoddard, et al., 2012, Jernigan, et al., 2016), including exposure through social media (Moreno & Whitehill, 2014, Kelleghan, et al., 2020). Contrasting with other forms of media, many digital media platforms are not subject to the same degree of regulation regarding displaying substance-

related content to minors, and any existing digital safeguards are generally easy to circumnavigate (Noel & Babor, 2017, Radoš Krnel, et al., 2023).

However, while some studies have demonstrated associations between PIU and substance use (Ko, et al., 2008, Rucker, et al., 2015, Morioka, et al., 2017), a 2020 systematic review found that quality evidence is lacking and concluded that there was not enough evidence to determine an association between PIU and alcohol use and cannabis use (Lanthier-Labonté et al., 2020).

Thus, despite the significant known consequences of adolescent substance use and substance use disorders, there is still little scientific consensus about whether Internet use is a relevant risk factor. Research studies on PIU and co-morbid substance use are still relatively few in number (Lanthier-Labonté et al., 2020), and there are even fewer studies examining the potential relevance of different types of digital media/Internet use and online substance-related exposures. Studies that examine online exposure to drug and alcohol-related content tend to focus primarily on digital exposure to substance use through advertising (Romer & Moreno, 2017), and often in only one digital modality (e.g. social media platforms, Internet gaming). A 2017 systematic review concluded that there is a dearth of research exploring exposure to substance use across peer and social media networks of influence (Romer & Moreno, 2017).

Limitations of PIU Research Methodology

In addition to being limited by the number of existing studies, the lack of scientific consensus surrounding the relationship between digital media and substance use may lie in study methodology. Most studies of PIU to date are cross-sectional and cannot

determine whether PIU is a causative factor in the development of substance use, or whether youth with problematic substance use are simply more likely to develop PIU. Moreover, both types of problematic use might influence one another; Neville et al. determined that associations between screen time and externalizing, high-risk behaviors were bi-directional in nature (Neville et al., 2021).

Additionally, cross-sectional research is vulnerable to recall bias, and individuals may not be accurate in recalling the amount of time they spend on screens, nor its impact on their day-to-day functioning. A 2020 study by Kaye et. al found that people consistently underestimate the amount of time spent on their smartphones, and overestimate the amount of time they spend on social media (Kaye et al., 2020). Adolescents, especially those with executive functioning challenges, frequently have an impaired sense of timing (Issakson et. al 2018), likely making them even more vulnerable to inaccurate recall of digital media use. With many teenagers endorsing the use of several platforms such as online videos, social media, and mobile games each day (Rideout, et al., 2022), it is likely challenging to recall specific daily app use and time spent on each app.

Ecological Momentary Assessment to Reduce Bias in PIU Research

Ecological Momentary Assessment (EMA) is a research methodology that can address some of these study limitations. EMA entails short, repeated assessments captured in a subject's natural environment, creating a high degree of ecological validity (Russel & Gajos, 2020). Smartphones are an ideal tool for EMA in general, but particularly for adolescents, with 88% of U.S. adolescents owning a personal smartphone

(Rideout, et al., 2022). Smartphones are also capable of collecting sensor data, such as global positioning system (GPS) and accelerometer data, as well as screen time data that is provided daily to the user through the smartphone operating system. Smartphone-based EMAs use “in the moment” sampling via personal smartphone and therefore reduce both recall bias and barriers to survey adherence.

EMA is validated for use in adolescents, including those with mental health conditions (Heron et al., 2017), and there appear to be no significant differences in compliance between EMA studies and clinical studies in youth (Wen et al., 2017). While studies using EMA to assess PIU are limited, existing research studies have considered the methodology to be feasible in youth with psychiatric comorbidities (Gansner et al., 2020).

Current Study and Specific Aims

This pilot study sought to clarify the relationship between Internet and substance use through use of a smartphone-based EMA protocol and collection of specific information detailing not only the amount of Internet use, but the type of digital media use, and PIU symptoms. Through collection of these data, this study aimed to 1) examine the relationship between daily PIU symptoms and exposure to substance-related content through digital media, 2) assess the relationship between daily PIU symptoms, substance use, and active urge to use substances, 3) determine associations between daily exposure to different types of substance-related content, instances of substance use, and active urge to use substances, and finally 4) determine associations between type of digital media use and incidence of exposure to substance-related content through digital media.

Based on prior studies highlighting positive correlations between PIU and substance use, it was hypothesized that days with greater PIU severity would be more likely to co-occur with instances of substance use. Moreover, given studies indicating potential influences of online drug-related exposures on subsequent substance use, we hypothesized that exposure to drug-related content online would also correlate with reports of both urge to use substances and instances of actual substance use. Finally, in light of studies detailing both influence of and frequent exposure to social media-related posts, and now videos, about alcohol and drug use, we hypothesized that increased time spent on social media use would be positively correlated with likelihood of exposure to drug-related content; specifically, frequent use of video-based social media platforms (e.g. TikTok) would be associated with increased incidence of online drug and alcohol-related exposures.

Digital media is part of daily life for most U.S. teenagers, who spend on average a third of their day using digital media (Rideout, et al., 2022). The COVID-19 pandemic likely contributed to a sharp rise in digital media use as well as an exponential increase in adolescent overdose deaths. The number of U.S. adolescents who died from overdose increased exponentially in 2020 and 2021 (Friedman, et al., 2022). Prior to the pandemic, the number of adolescent overdose deaths each year remained constant from 2010 to 2019 (Friedman, et al., 2022). Official counts are not yet available for 2022. However, projected counts show the number of overdose deaths holding constant and not returning to pre-pandemic levels in 2022 (Ahmad, et al., 2023).

Social media platforms and apps such as Snapchat, Instagram, and WhatsApp are increasingly being used to purchase substances for illicit use, especially by teenagers (Moyle, et al., 2019). With increasing time spent on digital media, increasing overdose deaths, and increasing purchase of substances through digital media, understanding the relationship between PIU and substance use, digital substance exposure and substance use, and app use and substance exposure is essential to be able to advise teenagers and their families on the risks of Problematic Internet Use as well as different types of digital media and how to use them safely. It is also important to understand these relationships to be able to craft interventions to help treat PIU and SUD, especially in this population.

METHODS

Recruitment

This pilot study recruited 26 adolescents and young adults between the ages of 13 and 23 (average age 15.96 years) of both sexes from outpatient psychiatry clinics associated with Cambridge Health Alliance (CHA). Eligibility to participate was based on the following criteria: informed consent, or informed consent of guardian and informed assent if under 18; ownership of a smartphone (which was needed to run the app used for data collection); access to Wi-Fi; and ability to speak English, as the app is only available in English currently. Participants were recruited through fliers, referrals by their mental health clinician, direct messaging via the electronic medical record, and active recruiting in clinic waiting rooms. Youth were compensated for their participation in the study with a \$50 Amazon gift card at the exit visit. Compensation was not linked to daily app use. Participants were still compensated even if they did not open the app in order to avoid coercion. Participants (and guardians if <18) met with the principal investigator or approved study team member, in-person or via phone, for an initial visit to obtain informed consent/assent and to be taught how to use the smartphone app required for the study.

Study Design

Participants used the mindLAMP app to fill out and respond to validated clinical screens and qualitative questionnaires. The mindLAMP app is a non-commercial app designed to be used in research (Torous, 2023). Study participants were sent daily reminders to fill-out daily questionnaires via app push notifications. The study lasted four

weeks, during which time participants were asked four validated clinical screens daily and three qualitative questionnaires daily. Participants filled out the DAST-A and NM-ASSIST during their initial study visit and then again during their exit visit. The DAST-A is a clinical screen designed to assess high-risk substance use and substance abuse, specifically in adolescents. The NM-ASSIST was modified to ask participants about their symptoms in the past month, rather than the past 3 months, in order to coincide with the duration of the study. Additionally, questions regarding alcohol use were added to the NM-ASSIST. The NM-ASSIST is designed to assess severity of substance use of multiple different types of substances. The DAST-A and NM-ASSIST are located in the appendix.

Daily, study participants were asked to fill out the modified PHQ-8, modified GAD-7, PIUQ-SF-6, and CRAFFT Part A. The PHQ-8 scale assessed depressive symptoms and was modified from the standard PHQ-9 to omit the question about active suicidality, as researchers had no way to monitor the answers live. The GAD-7 scale assessed anxiety. The PIUQ-SF-6 assessed daily symptoms associated with Problematic Internet Use, such as Internet craving and the denial of responsibilities to use the Internet. The CRAFFT Part A scale assessed daily substance use. It was modified to ask whether participants had engaged in substance use in the past day, rather than the past 12 months. The PHQ-8, GAD-7, and PIUQ-SF-6 were also modified to ask participants about their symptoms that day, rather than the past week. Participants would endorse symptoms of depression, anxiety, or PIU over the past day as “0= not at all”, “1= several times that day”, “2= more than half the day”, and “3= nearly the whole day”. The

modified PHQ-9 scale was found to be of equal clinical utility as bi-weekly traditional PHQ-9 (Bauer, et al., 2018). The clinical screens are located in the appendix.

Participants were also asked to fill out qualitative questionnaires daily regarding digital exposure to substance use and screen time. Participants were asked a combination of open-ended and yes/no questions about their potential exposure to substance-related content online and their urge to use substances. They were asked to report urge to use substances, intentional exposure to substance-related content online, unintentional exposure to substance-related content online, and exposure to substance-related content through peers' posts. They were asked whether their peers posted substance use-related content and whether their peers posted content about the peers' personal substance use. The qualitative questionnaire is found in the appendix. Participants with iPhones were asked to input screen time, screen time spent on social media, and top three apps used that day from the iPhone screen report app.

Psychiatric diagnostic information for participants was collected from their online medical record. The most recent notes from mental health clinicians were accessed and the diagnoses listed were recorded.

Data Processing and Analysis

Collected data was processed in Excel. Data was grouped first by individual participants and then within individual participants by day. Individuals' daily scale scores were calculated. Nonsense answers were removed, for example if a participant recorded "a lot" for screen time rather than a numerical value. If participants submitted a scale more than once per day, the second submission was used and the first response was

assumed to have been incorrect, or updated, and was deleted. Clinically significant anxiety symptoms, depression symptoms, and Problematic Internet Use symptoms were determined by applying accepted PHQ-8, GAD-7, and PIUQ-SF-6 cutoffs to the daily total scores. Substance use and type of substance were determined by responses to CRAFFT-A. Percent social media time was calculated using participant reported total screen time and total time spent on social media. Majority screen time spent on social media was defined as participants who had a percent social media time of 50% or greater. Apps endorsed by participants in their top 3 daily apps were categorized by type. The categories were personal communication, forum, music, shopping, videos, social media videos, gaming, web surfing and tv.

Analyses were run using Stata, version 14.2. Multi-level mixed models were used to account for longitudinal data. All analyses were controlled for age, gender and race/ethnicity. Significance was defined as a p value less than or equal to 0.05. Both multi-level mixed linear regression and multi-level mixed logistic regression were used. Multi-level mixed linear regression was used to analyze relationships between the following: PIU score and urge; PIU score and substance use; CRAFFT-A score and exposure via a peer's post of their personal substance use; PIU score and exposure via a peer's post of their personal substance use; PIU score and exposure via a peer's post regarding non-personal substance use; and CRAFFT-A score and exposure to substance use online. Multi-level mixed logistic regression was used to analyze the following: top app use and online exposure to substance-related content; app use and exposure to substance use via peers' posts of their personal substance use; app use and exposure to

substance use via peers' posts about non-personal substance use; and urge to use substances and clinically significant problematic Internet use.

RESULTS

Demographics

Twenty-six participants completed the entry and exit visits and filled out at least one day of scales and questionnaires. The demographics of these participants are summarized in Table 1. The average age of our participants was 15.96 years, with a standard deviation of 1.75 years. A slight majority of individuals in our study identified as female and white, non-Hispanic/Latinx.

Characteristics	Values
Total	26
Age (years), mean (SD)	15.96 (1.75)
Gender, n (%)	
Female	16 (61.5)
Male	7 (30.0)
Transgender or Non-binary	3 (11.5)
Race, n (%)	
White non-Hispanic/Latinx	14 (53.9)
Black non-Hispanic/Latinx	4 (15.4)
Hispanic or Latinx	3 (11.5)
Bi-racial	4 (15.4)
Other	1 (3.8)

Table 1. Demographics of Participants

PIU and Exposure to Substance Use through Digital Media

On days where youth reported higher PIU, they were more likely to report more un-intentional exposure to substance use through digital media. They were also more likely to be exposed to substance use through peers, both through peers' posts about substance use generally and through peers' posts of the peers' own personal substance use. Total screen time was not significantly correlated to exposure to substance use through digital media of any kind.

Exposure Type	β	p-value
Intentional Exposure	-0.075	0.931
Unintentional Exposure	0.773	0.024*
Peer Exposure	1.275	0.005*
Peer's Non-personal Post	1.444	0.003*
Peer's Personal Post	1.389	0.004*

Table 2. Relationship between PIU and Substance Use Exposure via Digital Media

PIU and Substance Use and Urge to Use Substances

On days when youth endorsed higher PIU as measured by the PIUQ-SF-6, they were 3.209 times less likely to report substance use (p-value 0.017). Analyses were controlled for urge to use substances and exposure to substance-related content through digital media. When youth endorsed higher PIU symptoms they were 1.362 times more likely to endorse active urge to use substances (p-value 0.006), when controlling for exposure through digital media. On days where youth reported clinically significant PIU symptoms (defined as a PIUQ-SF-6 score greater than 15), they were 2.978 times more likely to report an active urge to use substances (p-value 0.001). Total screen time was not significantly correlated with substance use.

	CRAFFT-A		Urge	
	β	p-value	β	p-value
PIU	-3.209	0.017*	1.362	0.006*
PIU > 15	-0.009	0.691	2.987	0.001*
Screen time	-9.649	0.894		

Table 3. PIU and Substance Use and Urge to Use Substances

Types of Digital Media Exposure and Substance Use and Urge

Substance use, measured by the CRAFFT-A scale, was significantly positively correlated with exposure to substance use through digital media. Specifically, a participant's substance use was significantly positively correlated to exposure through a peer's post of the peer's own personal substance use. It was not found to be significantly correlated with exposure to peers' posts about non-personal substance use or to exposure through group posts. Active urge to use substances was not significantly correlated with exposure to substance use through digital media.

Exposure Type	β	p-value
General Digital	0.043	0.039*
Peer's personal post	0.077	0.011*
Peer's non-personal post	-0.027	0.349
Group	-0.003	0.980

Table 4. Relationship between CRAFFT-A and Digital Media Exposure Type

Types of Digital Media Use and Exposure to Substance Use through Digital Media

Days where youth used apps with direct messaging capabilities frequently, measured as the app being recorded as one of youth's top 3 apps that day, were significantly positively correlated with exposure to substance use through digital media (p-value 0.036, Table 6). These days were also significantly positively correlated with exposure to substance use through peers' posts about the peers' personal substance use (p-value 0.013, Table 6) and peers' posts about non-personal substance use (p-value 0.028, Table 6). Days where gaming was one of the youth's top 3 apps were significantly correlated with exposure to substance use through digital media (p-value 0.046, Table 6).

However, gaming was not significantly associated with exposure to substance use through peers' posts or peers' posts of personal substance use. Other types of apps such as forums, music, shopping, videos, social media videos, web surfing, and tv were not significantly correlated with digital media exposure to substance use of any type. Time spent on social media, percent of screen time spent on social media, and spending the majority of screen time on social media were also not significantly correlated with digital media exposure to substance use.

Category	Examples
Personal Communication	iMessage, What's App
Forum	Discord
Music	Spotify, Apple Music
Shopping	Amazon Prime
Videos	YouTube, TikTok
Social Media Videos	TikTok
Non-Social Media Vidoes	Youtube
Websurfing	Safari, Google Chrome
TV	Hulu, Netflix, Disney+

Table 5. App Type

App Type	General Exposure		Peer's Post		Peer's Personal	
	β	p-value	β	p-value	β	p-value
Personal	0.882	0.036*	1.429	0.028*	1.727	0.013*
Communication						
Forum	-0.718	0.465	omitted	n/a	omitted	n/a
Music	-1.032	0.076	-1.652	0.143	-0.323	0.671
Shopping	-1.243	0.361	-1.068	0.513	-0.669	0.700
Videos	0.049	0.905	-0.269	0.644	-0.527	0.383
Social Media Videos	0.127	0.753	-0.198	0.731	-0.458	0.443
Game	0.942	0.046*	0.596	0.421	0.887	0.261
Web Surfing	-0.073	0.843	-0.259	0.657	-0.335	0.596
TV	0.275	0.548	-0.219	0.758	-0.703	0.432

Table 6: Relationship between App Type and Online Exposure to Substance Use

DISCUSSION

Findings

Using novel smartphone EMA, our data suggests that on days where youth report more PIU symptoms they are more likely to be exposed to substance use through digital media, but they are less likely to use substances. Youth who spend the majority of their screen time on apps with direct messaging capabilities such as iMessage are more likely to be exposed to substance use, and more likely to be exposed to substance use through peers' posts of their personal and non-personal substance use. On days where youth were exposed to substance use through peers' posts of their personal substance use, they were also more likely to use substances themselves.

This pilot study is one of the first to explore the relationship between PIU and exposure to substance use through digital media and, to our knowledge, the first of its kind using EMA methodology. We hypothesized that on days where participants endorsed more PIU symptoms they would also report more exposure to substance use through digital media. Our data supports this hypothesis. Youth were more likely to report unintentional exposure to substance use through digital media. Intentional substance use exposure through digital media was not significantly related. It follows that, if youth are spending more time online, they may be more likely to encounter substance-related content. However, total screen time was not significantly correlated with exposure to substance-related content. Our data suggests, then, that it could be the type of media youth are consuming when they are experiencing PIU symptoms that

makes them more likely to be exposed to substance-related content, rather than the overall amount of time spent online.

On days when youth were experiencing more PIU symptoms, they were also more likely to be exposed to substance use content online through peer exposure. They were more likely to be exposed to both peers' posts about their personal substance use and peers' posts about general substance use. These data suggest that on days where youth are experiencing more PIU symptoms, they may prefer to use types of digital media that more frequently expose them to peers' content about substance use (e.g. social media platforms).

We also hypothesized that PIU would be directly correlated to actual substance use and active urge to use substances. There is conflicting evidence for a relationship between PIU and substance use in adolescents. Although a 2020 review found no strong evidence for a relationship between PIU and substance use in adolescents (Lanthier-Labonté et al., 2020), multiple prior studies found a relationship between PIU and problem alcohol use and substance use (Ko et al., 2008, Rucker, et al., 2015, Morioka, et al., 2017). Our data suggest that there is a significant direct relationship between PIU and active urge to use substances. This relationship appeared even stronger when adolescents reported clinically significant PIU symptoms, defined as a PIUQ-SF-6 score greater than, or equal to, 15. However, when urge and exposure were controlled for (given their likelihood to be related to substance use), adolescents were actually less likely to use substances on days with more PIU symptoms. These results may provide further evidence that PIU represents a maladaptive coping skill. Prior studies that have hypothesized a bi-

directional relationship between PIU and depressive/anxiety symptoms have previously theorized that PIU might be a coping skill for managing psychiatric symptoms rather than the cause (Gansner, et al., 2022). PIU might be a way for youth struggling with substance use to distract themselves from the active urge to use substances and to avoid engaging in substance use. Youth who are strongly feeling cravings for substances may also be more sensitive to cravings to use the Internet, therefore scoring higher on the PIUQ-SF-6.

We also hypothesized that increased exposure to substance use through digital media would be correlated to actual substance use. Our data supported this. On days where youth were exposed to substance use content online they were more likely to engage in substance use. We examined exposure type in more detail, and found that when youth were exposed to substance use content in the form of a peer's post about their personal substance use, participants were more likely to engage in substance use themselves. They were not more likely to engage in substance use when exposed to a peer's post about general substance use or when exposed to a post about substance use in an online group setting (e.g. a forum).

These results suggest that youth are more vulnerable to be influenced by their friends' or peers' actions rather than general substance use content. Adolescence is often characterized by a growing importance of peer relationships. A 2000 study found that peer use of alcohol was correlated with adolescent substance use, and that peer or sibling use of alcohol was more strongly correlated with adolescent substance use than parental use of alcohol (Windle, 2000). A 2001 review summarized that the influence of peers on personal high risk alcohol use was mediated through direct influences, modeling, and

perceived norms (Borsari & Carey, 2001). Few studies have explored the potential impact of exposure to substance use through digital media. Prior studies that have examined the relationship between exposure to substance use online and substance use have primarily focused on advertising. Stoddard et al. found that alcohol use was associated with more social media alcohol content in college students (Stoddard, et al., 2012). Our data suggest that adolescents may be more vulnerable to peers' influence than advertising. Viewing peers' substance-related content may increase adolescent substance use through modeling and perceived norms. If adolescents see their peers engaging in substance use or are told about their peers engaging in substance use, they may model the behavior. Adolescents may also perceive substance use to be a norm amongst their peers and be more likely to engage. Further, a 2023 review of the portrayal of substance use on social media found that in the majority of the content, substance use was portrayed positively (Rutherford, et al., 2023). Positive portrayals of substance use may skew adolescents' perceptions of substance use, showing the "benefits" of substance use, ignoring the risks, and suggesting substance use is "cool". This could influence adolescents to be more susceptible to engage in substance use. While future study is needed, our data reaffirms concerns about "peer pressure" and influence of friends on adolescents.

Finally, we hypothesized that a majority of screen time spent on social media would result in increased exposure to substance use, and that participants who had videos, specifically social media platforms predominantly featuring videos, as one of their top apps for the day would have more exposure to substance use on those days. We did not find a significant relationship between time spent on social media and exposure to

substance use through digital media. Additionally, spending greater than fifty percent of screen time on social media was also not associated with exposure to substance use through digital media.

Sixty-seven percent of U.S. adolescents say they use the online social media video platform TikTok (Pew Research Center, 2022). According to TikTok’s community guidelines they “do not allow the depiction, promotion, or trade of drugs or other controlled substances. The trade of tobacco and alcohol products is also prohibited on the platform.” (TikTok, 2022). Ninety-five percent of U.S. adolescents say they use the online video platform YouTube (Pew Research Center, 2022). YouTube’s community guidelines prohibit “Minors using alcohol or drugs: Showing minors drinking alcohol, using vaporizers, e-cigarettes, tobacco or marijuana, or misusing fireworks.” (YouTube, 2022). It is possible that these restrictions are effective in limiting the amount of substance-related content adolescents are exposed to on these platforms, especially the amount of exposure to content of peers personally using substances.

However, days where an app with direct messaging capabilities was a top three app were significantly correlated to increased exposure to substance use content. Having an app with direct messaging capabilities as a top-used app for the day was also significantly correlated with exposure to substance use content through peers’ posts about both personal substance use and general substance use. Exposure to substance use was also related to having gaming as a top three app, but not associated with exposure to substance use through peers’ content, only to substance use-related content in general. This raises the potential that exposure could be through advertisements or content of the

games themselves. A 2016 study found that many of the most popular video games, such as Call of Duty: Black Ops II and Grand Theft Auto V, contain significant amounts of substance-related content (Cranwell, et al., 2016). Our data did not find a relationship between frequent use of other apps and exposure to substance use content through digital media.

Our data suggest that it may not be social media itself, but the direct messaging components of some social media platforms, that increase adolescents' risk for exposure to substance use content. Adolescents are exposed to peers' substance use and content about substance use from peers through these platforms. This is of particular interest because exposure to substance use through a peer's post about their personal substance use specifically was correlated with increased substance use. Direct messaging platforms, such as iMessage and WhatsApp, are interpersonal communications and are not subject to app-wide content moderation. This likely makes it easier for youth to share substance-related content on these platforms versus other platforms with content moderation. While this research is preliminary, it may be prudent for clinicians to counsel patients and guardians about the risks of social media platforms with direct messaging and the frequent use of those platforms. Clinicians and families may want to review the potential impact of digital peer relationships on substance use with adolescents. It may also be helpful for clinicians to discuss the relationship between gaming and exposure to substance use content, as exposure to general substance use content online was also correlated with engagement in substance use.

Limitations

Our study had several limitations. Most notably, this was a pilot study with a sample size of only 26 participants, which limited our statistical power. Future research should include a much larger sample size. Additionally, a slight majority of our participants were white and female. A 2012 report found that Black youth are exposed to more alcohol advertising than their white peers, however were less likely to drink alcohol than their white peers (The Center on Alcohol Marketing and Youth, 2012). Black youth and Hispanic youth are also more likely to use TikTok, Instagram, Twitter, and WhatsApp as compared to white youth (Pew Research Center, 2022). While neither report examined exposure through online media, they raise the question of whether different races and ethnicities have different amounts of exposure to substance-related content online and different responses to online exposure. Further, all of our participants had mental health diagnoses prior to study participation. This limits the generalizability of our findings to the larger adolescent population. Substance use is more prevalent among adolescents with mental illness and the patterns of substance use and influence of exposures and peer exposures may be different among adolescents who do not have mental illness. PIU is also more prevalent among adolescents with mental illness, and patterns involving Internet use and online substance use exposures may also differ from adolescents without mental illness. Future studies should examine a more general population and also explore whether adolescents with mental illness have different Internet use and substance use patterns than adolescents without.

Our study also used self-report scales, the PIUQ-SF-6 and CRAFFT part A, and asked self-report questions like “were you exposed to substance use while you were online today?” Participants could potentially give untrue answers on self-report scales due to feeling embarrassed or feeling like they needed to give a specific answer. A 2021 study found that the prevalence of substance use was much higher when measured by a urine screen as compared to self-report screens in the same patients (Khalili et al., 2021). Participants who engaged in substance use may not have felt comfortable endorsing substance use. Additionally, participants may not have felt comfortable answering questions about exposure to substance use, especially about exposure to a peer’s personal substance use. Therefore, our study may have under-reported substance use and exposure to substance use, as well as problematic Internet use.

Future Directions

Greater powered research is needed to expand on the relationship between certain types of digital media use and exposure to substance-related content, exposure to substance use-related content online, and actual substance use. Such further research is also needed to expand on the relationship between PIU and substance use. Further research could also examine whether the relationship between digital media use, exposure to substance-related content, and substance use patterns vary between adolescents with mental illness and those without, and whether they vary between adolescents of different races and ethnicities. More research is needed to develop guidelines for clinicians to counsel their patients and their families about safe or safer digital media use. Specifically, guidelines should focus on the risks of using social media platforms with direct

messaging capabilities. Studies should explore potential dose-dependence of both time spent on social media platforms with direct messaging and substance-related content exposure, and substance-related content exposure and engagement in substance use.

Conclusions

Our study suggests that adolescents who use social media platforms with direct messaging capabilities are more frequently exposed to online substance use content and adolescents who are exposed to substance use content, especially about peers' substance use, are more likely to use substances. Our research also suggests that active PIU symptoms may increase one's risk of being exposed to substance-related content. Further, our findings support a growing belief that PIU may be a coping mechanism for youth to avoid substance use, rather than a predictor of it. Additional research is needed, but clinicians could consider offering preliminary guidance to patients and their families about the risks of frequent use of social media platforms with direct messaging capabilities, as well as screening for PIU in adolescents engaged in substance use. Clinicians then might be able to recommend alternate coping skills to substance-using youth who endorse high PIU symptoms.

APPENDIX

DAST-A

One point for each bold answer. 6 points or greater indicates substance abuse

1. Have you used drugs other than those required for medical reasons?

Yes No

2. Have you abused prescription drugs?

Yes No

3. Do you abuse more than one drug at a time?

Yes No

4. Can you get through the week without using drugs (other than those required for medical reasons)?

Yes No

5. Are you always able to stop using drugs when you want to?

Yes **No**

6. Do you abuse drugs on a continuous basis?

Yes No

7. Do you try to limit your drug use to certain situations?

Yes No

8. Have you had “blackouts” or “flashbacks” as a result of drug use?

Yes No

9. Do you ever feel bad about your drug abuse?

Yes No

10. Does your boyfriend/girlfriend or parents ever complain about your involvement with drugs?

Yes No

11. Do your friends or relatives know or suspect you abuse drugs?

Yes No

12. Has drug abuse ever created problems between you and your boyfriend/girlfriend or parents?

Yes No

13. Has any family member ever sought help for problems related to your drug use?

Yes No

14. Have you ever lost friends because of your use of drugs?

Yes No

15. Have you ever neglected your family or missed work because of your use of drugs?

Yes No

16. Have you ever been in trouble at work because of drug abuse?

Yes No

17. Have you ever been kicked out of school or lost a job because of drug abuse?

Yes No

18. Have you ever gotten into fights when under the influence of drugs?

Yes No

19. Have you ever been arrested because of unusual behavior while under the influence of drugs?
- Yes** No
20. Have you ever been arrested for driving while under the influence of drugs?
- Yes** No
21. Have you engaged in illegal activities to obtain drugs?
- Yes** No
22. Have you ever been arrested for possession of illegal drugs?
- Yes** No
23. Have you ever experienced withdrawal symptoms as a result of heavy drug intake?
- Yes** No
24. Have you had medical problems as a result of your drug use (e.g., memory loss, hepatitis, convulsions, or bleeding)?
- Yes** No
25. Have you ever gone to anyone for help for a drug problem?
- Yes** No
26. Have you ever been in the hospital for medical problems related to your drug use?
- Yes** No
27. Have you ever been involved in a treatment program specifically related to drug use?
- Yes** No

28. Have you been treated as an outpatient for problems related to drug abuse?

Yes

No

NM-ASSIST

Question 1 of 8, NIDA-Modified ASSIST	Yes	No
<p>In your <i>LIFETIME</i>, which of the following substances have you ever used?</p> <p><i>*Note for Physicians: For prescription medications, please report nonmedical use only.</i></p>		
a. Cannabis (marijuana, pot, grass, hash, etc.)		
b. Cocaine (coke, crack, etc.)		
c. Prescription stimulants (Ritalin, Concerta, Dexedrine, Adderall, diet pills, etc.)		
d. Methamphetamine (speed, crystal meth, ice, etc.)		
e. Inhalants (nitrous oxide, glue, gas, paint thinner, etc.)		
f. Sedatives or sleeping pills (Valium, Serepax, Ativan, Xanax, Librium, Rohypnol, GHB, etc.)		
g. Hallucinogens (LSD, acid, mushrooms, PCP, Special K, ecstasy, etc.)		
h. Street opioids (heroin, opium, etc.)		
i. Prescription opioids (fentanyl, oxycodone [OxyContin, Percocet], hydrocodone [Vicodin], methadone, buprenorphine, etc.)		
j. Other – specify:		

- Given the patient’s response to the Quick Screen, the patient *should not indicate “NO”* for all drugs in Question 1. If they do, remind them that their answers to the Quick Screen indicated they used an illegal or prescription drug for nonmedical reasons within the past year and then repeat Question 1. If the patient indicates that the drug used is not listed, please mark ‘Yes’ next to ‘Other’ and continue to Question 2 of the NIDA-Modified ASSIST.
- If the patient says “Yes” to any of the drugs, proceed to Question 2 of the NIDA-Modified ASSIST.

Question 2 of 8, NIDA-Modified ASSIST					
2. <u>In the past three months</u> , how often have you used the substances you mentioned (first drug, second drug, etc)?	Never	Once or Twice	Monthly	Weekly	Daily or Almost Daily
• Cannabis (marijuana, pot, grass, hash, etc.)	0	2	3	4	6
• Cocaine (coke, crack, etc.)	0	2	3	4	6
• Prescription stimulants (Ritalin, Concerta, Dexedrine, Adderall, diet pills, etc.)	0	2	3	4	6
• Methamphetamine (speed, crystal meth, ice, etc.)	0	2	3	4	6
• Inhalants (nitrous oxide, glue, gas, paint thinner, etc.)	0	2	3	4	6
• Sedatives or sleeping pills (Valium, Serepax, Ativan, Librium, Xanax, Rohypnol, GHB, etc.)	0	2	3	4	6
• Hallucinogens (LSD, acid, mushrooms, PCP, Special K, ecstasy, etc.)	0	2	3	4	6
• Street opioids (heroin, opium, etc.)	0	2	3	4	6
• Prescription opioids (fentanyl, oxycodone [OxyContin, Percocet], hydrocodone [Vicodin], methadone, buprenorphine, etc.)	0	2	3	4	6
• Other – Specify:	0	2	3	4	6

- For patients who report “Never” having used any drug in the past 3 months: **Go to Questions 6-8.**
- For any recent illicit or nonmedical prescription drug use, go to **Question 3.**

3. <u>In the past 3 months</u> , how often have you had a strong desire or urge to use (first drug, second drug, etc)?	Never	Once or Twice	Monthly	Weekly	Daily or Almost Daily
a. Cannabis (marijuana, pot, grass, hash, etc.)	0	3	4	5	6
b. Cocaine (coke, crack, etc.)	0	3	4	5	6
c. Prescribed Amphetamine type stimulants (Ritalin, Concerta, Dexedrine, Adderall, diet pills, etc.)	0	3	4	5	6
d. Methamphetamine (speed, crystal meth, ice, etc.)	0	3	4	5	6
e. Inhalants (nitrous oxide, glue, gas, paint thinner, etc.)	0	3	4	5	6
f. Sedatives or sleeping pills (Valium, Serepax, Ativan, Librium, Xanax, Rohypnol, GHB, etc.)	0	3	4	5	6
g. Hallucinogens (LSD, acid, mushrooms, PCP, Special K, ecstasy, etc.)	0	3	4	5	6
h. Street Opioids (heroin, opium, etc.)	0	3	4	5	6
i. Prescribed opioids (fentanyl, oxycodone [OxyContin, Percocet], hydrocodone [Vicodin], methadone, buprenorphine, etc.)	0	3	4	5	6
j. Other – Specify:	0	3	4	5	6

4. <u>During the past 3 months</u> , how often has your use of (first drug, second drug, etc) led to health, social, legal or financial problems?	Never	Once or Twice	Monthly	Weekly	Daily or Almost Daily
a. Cannabis (marijuana, pot, grass, hash, etc.)	0	4	5	6	7
b. Cocaine (coke, crack, etc.)	0	4	5	6	7
c. Prescribed Amphetamine type stimulants (Ritalin, Concerta, Dexedrine, Adderall, diet pills, etc.)	0	4	5	6	7
d. Methamphetamine (speed, crystal meth, ice, etc.)	0	4	5	6	7
e. Inhalants (nitrous oxide, glue, gas, pain thinner, etc.)	0	4	5	6	7
f. Sedatives or sleeping pills (Valium, Serepax, Ativan, Librium, Xanax, Rohypnol, GHB, etc.)	0	4	5	6	7
g. Hallucinogens (LSD, acid, mushrooms, PCP, Special K, ecstasy, etc.)	0	4	5	6	7
h. Street opioids (heroin, opium, etc.)	0	4	5	6	7
i. Prescribed opioids (fentanyl, oxycodone [OxyContin, Percocet], hydrocodone [Vicodin], methadone, buprenorphine, etc.)	0	4	5	6	7
j. Other – Specify:	0	4	5	6	7

5. <u>During the past 3 months</u> , how often have you failed to do what was normally expected of you because of your use of (first drug, second drug, etc)?	Never	Once or Twice	Monthly	Weekly	Daily or Almost Daily
a. Cannabis (marijuana, pot, grass, hash, etc.)	0	5	6	7	8
b. Cocaine (coke, crack, etc.)	0	5	6	7	8
c. Prescribed Amphetamine type stimulants (Ritalin, Concerta, Dexedrine, Adderall, diet pills, etc.)	0	5	6	7	8
d. Methamphetamine (speed, crystal meth, ice, etc.)	0	5	6	7	8
e. Inhalants (nitrous oxide, glue, gas, paint thinner, etc.)	0	5	6	7	8
f. Sedatives or sleeping pills (Valium, Serepax, Ativan, Librium, Xanax, Rohypnol, GHB, etc.)	0	5	6	7	8
g. Hallucinogens (LSD, acid, mushrooms, PCP, Special K, ecstasy, etc.)	0	5	6	7	8
h. Street Opioids (heroin, opium, etc.)	0	5	6	7	8
i. Prescribed opioids (fentanyl, oxycodone [OxyContin, Percocet], hydrocodone [Vicodin], methadone, buprenorphine, etc.)	0	5	6	7	8
j. Other – Specify:	0	5	6	7	8

Instructions: Ask Questions 6 & 7 for all substances ever used (i.e., those endorsed in the Question 1).

6. Has a friend or relative or anyone else <u>ever</u> expressed concern about your use of (first drug, second drug, etc)?	No, never	Yes, but not in the past 3 months	Yes, in the past 3 months
a. Cannabis (marijuana, pot, grass, hash, etc.)	0	3	6
b. Cocaine (coke, crack, etc.)	0	3	6
c. Prescribed Amphetamine type stimulants (Ritalin, Concerta, Dexedrine, Adderall, diet pills, etc.)	0	3	6
d. Methamphetamine (speed, crystal meth, ice, etc.)	0	3	6
e. Inhalants (nitrous oxide, glue, gas, paint thinner, etc.)	0	3	6
f. Sedatives or sleeping pills (Valium, Serepax, Xanax, Ativan, Librium, Rohypnol, GHB, etc.)	0	3	6
g. Hallucinogens (LSD, acid, mushrooms, PCP, Special K, ecstasy, etc.)	0	3	6
h. Street opioids (heroin, opium, etc.)	0	3	6
i. Prescribed opioids (fentanyl, oxycodone [OxyContin, Percocet], hydrocodone [Vicodin], methadone, buprenorphine, etc.)	0	3	6
j. Other – Specify:	0	3	6

7. Have you ever tried and failed to control, cut down or stop using (first drug, second drug, etc)?	No, never	Yes, but not in the past 3 months	Yes, in the past 3 months
a. Cannabis (marijuana, pot, grass, hash, etc.)	0	3	6
b. Cocaine (coke, crack, etc.)	0	3	6
c. Prescribed Amphetamine type stimulants (Ritalin, Concerta, Dexedrine, Adderall, diet pills, etc.)	0	3	6
d. Methamphetamine (speed, crystal meth, ice, etc.)	0	3	6
e. Inhalants (nitrous oxide, glue, gas, paint thinner, etc.)	0	3	6
f. Sedatives or sleeping pills (Valium, Serenax, Xanax, Ativan, Librium, Rohypnol, GHB, etc.)	0	3	6
g. Hallucinogens (LSD, acid, mushrooms, PCP, Special K, ecstasy, etc.)	0	3	6
h. Street opioids (heroin, opium, etc.)	0	3	6
i. Prescribed opioids (fentanyl, oxycodone [OxyContin, Percocet], hydrocodone [Vicodin], methadone, buprenorphine, etc.)	0	3	6
j. Other – Specify:	0	3	6

Instructions: Ask Question 8 if the patient endorses any drug that might be injected, including those that might be listed in the other category (e.g., steroids). Circle appropriate response.

8. Have you ever used any drug by injection (NONMEDICAL USE ONLY)?	No, never	Yes, but not in the past 3 months	Yes, in the past 3 months
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- Recommend to patients reporting any prior or current intravenous drug use that they get tested for HIV and Hepatitis B/C.
- If patient reports using a drug by injection in the past three months, ask about their pattern of injecting during this period to determine their risk levels and the best course of intervention.
 - If patient responds that they inject once weekly or less OR fewer than 3 days in a row, provide a brief intervention including a discussions of the risks associated with injecting.
 - If patient responds that they inject more than once per week OR 3 or more days in a row, refer for further assessment.

Note: Recommend to patients reporting any current use of alcohol or illicit drugs that they get tested for HIV and other sexually transmitted diseases.

Tally Sheet for scoring the full NIDA-Modified ASSIST:

Instructions: For each substance (labeled a–j), add up the scores received for questions 2-7 above. This is the Substance Involvement (SI) score. Do not include the results from either the Q1 or Q8 (above) in your SI scores.

Substance Involvement Score	Total (SI SCORE)
a. Cannabis (marijuana, pot, grass, hash, etc.)	
b. Cocaine (coke, crack, etc.)	
c. Prescription stimulants (Ritalin, Concerta, Dexedrine, Adderall, diet pills, etc.)	
d. Methamphetamine (speed, crystal meth, ice, etc.)	
e. Inhalants (nitrous oxide, glue, gas, paint thinner, etc.)	
f. Sedatives or sleeping pills (Valium, Serepax, Xanax, Ativan, Librium, Rohypnol, GHB, etc.)	
g. Hallucinogens (LSD, acid, mushrooms, PCP, Special K, ecstasy, etc.)	
h. Street Opioids (heroin, opium, etc.)	
i. Prescription opioids (fentanyl, oxycodone [OxyContin, Percocet], hydrocodone [Vicodin], methadone, buprenorphine, etc.)	
j. Other – Specify:	

Use the resultant Substance Involvement (SI) Score to identify patient’s risk level.

To determine patient’s risk level based on his or her SI score, see the table below:

Level of risk associated with different Substance Involvement Score ranges for Illicit or nonmedical prescription drug use	
0-3	Lower Risk
4-26	Moderate Risk
27+	High Risk

NM-ASSIST. We used a modified version asking about substance use in the past month rather than substance use in the past 3 months. “*NIDA Modified ASSIST*”. Reprinted from National Institute of Drug Abuse, 2010, National Institute of Health.

PHQ-8

Scale 0-24, each question between 0-3

0 never, 1 several times a day, 2 more than half the day, 3 (nearly) entire day

In the past day:

1. "How often were you bothered by little interest or pleasure in doing things?"
2. "How often were you bothered by feeling down, depressed, or hopeless?"
3. "How often did you have trouble falling or staying asleep, or sleep for more hours than you meant to?"
4. "How often did you feel tired or like you had little energy?"
5. "How often did you find yourself with no appetite, or eating more than you meant to?"
6. "How often did you feel bad about yourself, or that you were a failure or let your family down?"
7. "How often did you have trouble concentrating on things such as reading or watching TV?"
8. "How often did you find yourself moving so slowly, or so fidgety/restless, that others noticed?"

GAD-7

Scale 0-21, each question between 0-3

0 never, 1 several times a day, 2 more than half the day, 3 nearly the entire day

In the past day:

1. "How often did you feel nervous, anxious, or on edge?"
2. "How often did you feel as if you could not stop or control your worrying?"
3. "How often did you worry too much about different things?"
4. "How often did you have trouble relaxing?"

5. "How often were you so restless that you found it hard to sit still?"
6. "How often were you easily annoyed or irritated?"
7. "How often did you feel afraid, as if something awful was going to happen?"

PIU-SF-6

Scale 6-30, each question 1-5

1 never, 2 rarely, 3 sometimes, 4 often, 5 always/almost always

In the past day:

1. How often did you feel tense/ irritated/stressed when you couldn't be online as long as you wanted?
2. How often did you spend time online when you'd rather have been sleeping?
3. How often did you have sad/moody/nervous feelings OFFLINE that stopped when you went back online?
4. How often did people in your life complain that you were spending too much time online?
5. How often did you try to decrease the amount of time you spent online but were NOT able to?
6. How often did you try to conceal the amount of time you were spending online?

CRAFFT Part A

During the past day did you:

1. Drink any alcohol (more than a few sips)?

(Do not count alcohol taken during family or religious events.)

No Yes

2. Smoke any marijuana or hashish?

No Yes

3. Use anything else to get high?

(“anything else” includes illegal drugs, over the counter and prescription drugs and things you sniff or “huff”)

No Yes

Qualitative Assessment of Substance-Related Digital Media Exposure

1. Which Substances Have You Used Today to Get High?

None

Cannabis (marijuana, pot, grass, hash, etc.)

Cocaine (coke, crack, etc.)

Prescription stimulants (Ritalin, Concerta, Dexedrine, Adderall, diet pills, etc.)

Methamphetamine (speed, crystal meth, ice, etc.)

Inhalants (nitrous oxide, glue, gas, paint thinner, etc.)

Sedatives or sleeping pills (Valium, Serepax, Ativan, Librium, Xanax, Rohypnol, GHB, etc.)

Hallucinogens (LSD, acid, mushrooms, PCP, Special K, ecstasy, etc.)

Street opioids (heroin, opium, etc.)

Prescription opioids (fentanyl, oxycodone [OxyContin, Percocet], hydrocodone [Vicodin], methadone, buprenorphine, etc.)

Other

2. If no to the previous question, have you felt tempted to use any non-prescribed substance?

Yes No

3. In the past day, did you look for recreational, non-education drug or alcohol-related content online (e.g. videos about substance use)?

Yes No

4. In the past day, were you exposed to drug or alcohol-related content online (e.g. videos about substance use)?

Yes No

5. In the past day, did you participate in online groups related to drug or alcohol use?

Yes No

6. In the past day, did your friends online share or repost drug or alcohol-related content online (e.g. on social media)?

Yes No

7. In the past day, did your friends post online about their personal use of drug or alcohol-related content online (e.g. on social media)?

Yes No

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