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RESEARCH ARTICLE

Exploring the intersection of sexual identity and route of administration in relation to cannabis use among young adult females

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Abstract

Background and Objective: Rates of cannabis use continue to increase with sexual minority women (SMW) reporting greater use than heterosexual women. Along with these increasing trends, the routes of administration (ROA) for cannabis are evolving. The current study examined associations between cannabis ROA and frequency of use, as well as differences across sexual identity (heterosexual vs. SMW).

Methods: Participants were 949 young adult (18–25 years old) women (29.8% SMW) who reported past month cannabis use and were recruited through Amazon Mechanical Turk. Number of cannabis use days and each ROA used (joint, pipe, blunt, bong, vape, edible, and ointment) in the past 30 days were measured. Analysis of covariance models examined if sexual identity moderated the association between each ROA and cannabis use frequency.

Results: Among the full sample, joints were the most common ROA (78.6%); cannabis vaping was the most common noncombustible ROA (25.9%). SMW were more likely than heterosexual women to use each ROA except for joints. SMW who used pipes or edibles reported greater cannabis use frequency, compared to those who did not; there were no differences in frequency of use across ROA for heterosexual women.

Discussion and Conclusions: SMW may use a greater variety of ROA, potentially increasing the harms associated with cannabis. Marketing strategies targeting the sexual minority community may increase the likelihood of using various cannabis ROA and subsequent use.

Scientific Significance: Findings further our knowledge about how young adult women are using cannabis, and highlight how ROA may contribute to the disparities observed among SMW.

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INTRODUCTION

Rates of cannabis use among young adults in the United States are increasing,¹ with current estimates from the 2021 National Survey on Drug Use and Health (NSDUH) revealing that 24% of adults aged 18–25 report past-month cannabis use,² compared to 19.8% from 2015 NSDUH findings for this same age group.³ Emerging research has also shown that sexual minority women (SMW) are particularly high risk, reporting a greater likelihood of cannabis use than heterosexual women.^{4,5} For instance, data from the 2015–2017 NSDUH showed that lesbian and bisexual women were twice as likely to use cannabis in the past year, relative to heterosexual women.⁵ The higher rates of cannabis use among SMW are often attributed to experiencing discrimination related to their sexual identity (i.e., minority stress).⁶ That is, sexual minority individuals may cope with minority stress experiences by using cannabis. Substance use (i.e., cannabis, alcohol, and cigarette) to cope with sexual minority stress experiences has been supported in prior studies of SMW.^{7,8} The elevated rates of use are problematic given the association between frequent cannabis use and negative cannabis-related consequences (e.g., cannabis use disorder, mental health symptoms, abdominal pain and vomiting, and memory impairment).^{9–11} Alongside the increasing trends of cannabis use, the routes of administration (ROA) for cannabis have evolved. Understanding the impact of ROA on cannabis use may provide novel information for interventions and public health policies by identifying methods associated with greater cannabis use. Further, identifying sexual identity differences on this association could help target efforts to reduce the rates of cannabis use for SMW, specifically, a group with demonstrably higher risk. However, to date, no studies have examined the difference in ROA and cannabis use between heterosexual and SMW.

There are various ROA for cannabis. For example, individuals can smoke cannabis by heating it through burning a joint (cannabis rolled in paper), a blunt (cannabis rolled in cigar paper [tobacco leaf]), a pipe (used to smoke dry cannabis), or a bong (cannabis smoked through a water pipe). These combustible methods of smoking cannabis are the most common ROA,¹² but may be associated with differential risk. Data from the 2009–2012 NSDUH showed that using blunts on more days in the past month was associated with reporting more severe cannabis-related problems, relative to using on fewer days.¹³ Further, among a sample of cannabis treatment seeking adults, those who used blunts on more days in the past month had greater cannabis withdrawal symptoms.¹⁴ However, results from the same study showed that number of days of joint use were not significantly related to cannabis withdrawal symptoms, suggesting blunts are higher risk. These findings suggest that the additive effects of nicotine from blunts may exacerbate the addictive properties of cannabis, increasing withdrawal symptoms and making it more difficult to change cannabis use behavior. Additionally, a review of tobacco and cannabis co-use found that blunt smoking resulted in higher carbon monoxide (CO) levels than using joints or bowls,¹⁵ which may increase the risk of severe health consequences. Taken together, some combustible ROA may be riskier in terms of addictive properties and health concerns, specifically if used frequently.

Another way to administer cannabis is to vape it, which heats the cannabis oil or liquid that is then inhaled. A recent review article found that cannabis vaping is more common among young adults than older adults.¹⁶ Further, national estimates from the 2019 Monitoring the Future College Students and Young Adults Survey showed that 14% of college students and 17% of nonstudents reported past month cannabis vaping which is a substantial increase from 5% to 8% in 2017, respectively.¹⁷ College students who used cannabis more frequently in the past year were over three times more likely to report cannabis vaping than not vaping,¹⁸ indicating this may be a popular ROA for young adults. Although some research suggests that compared to combustible cannabis use, vaping may produce fewer chemicals, the cannabis potency is often higher from cannabis vaping which is associated with greater mental and physical health effects.¹⁹ Additionally, e-cigarette or vaping-associated lung injuries (EVALI) are common among people who vape cannabis.¹⁶ As of January 2020, 82% of hospitalized EVALI cases reported to the Centers for Disease Control and Prevention involved the use of cannabis vaping and 76% of patients were under 35 years old (median age = 24 years old),²⁰ indicating this ROA may include severe health risks, particularly for young adults.

Several less commonly used ROA are edibles (ingesting the cannabis through a food source such as a brownie, gummy) and ointments (e.g., lotion or oil are applied directly to the skin). Oral administration of cannabis through edibles may have a longer duration of being metabolized through the body and into the bloodstream.²¹ Thus, the effects of cannabis may be delayed and last longer, compared to other cannabis ROA. Nearly 10% of emergency department (ED) visits for cannabis between 2012 and 2016 in Colorado were attributed to consuming edibles.²² Of these ED visits that involved edible use, 48.3% were due to intoxication, 18.0% were for acute psychiatric symptoms (e.g., anxiety, psychosis), and 8.0% were for cardiovascular symptoms, which were higher than rates for inhaled cannabis visits (27.8%, 10.9%, and 3.1%, respectively). Individuals who use edibles may be unaware of the delayed and long-lasting effects of cannabis, thereby heightening risk for overuse. Cannabis ointments are commonly used for dermatologic conditions (e.g., acne, psoriasis), joint mobility, and headaches/migraines.^{23,24} Little information exists about the frequency of use or addictive potential via cannabis ointments.

Identifying prevalence rates across ROAs and associations with frequency of cannabis use can inform interventions that focus on educating individuals about the potential harms of cannabis, as well as policies surrounding the marketing and sale of these products. Although the long-term health effects of administering cannabis through these various ROA are unclear, it should be noted that some methods combine the use of cannabis and tobacco/nicotine products (e.g., blunts) thereby potentially increasing exposure to addictive properties of nicotine and cannabis. Given the elevated rates of cannabis use among SMW, it is critical to identify if their risk is amplified through choice of ROA to reduce health disparities among this high-risk population. If SMW are more likely than heterosexual women to use a ROA that involves tobacco and cannabis co-use, this may lead to greater health

consequences among this already high-risk group. The current study is exploratory and aimed to examine (1) the differences in rates of various ROA (joint, pipe, blunt, bong, vape, edible, and ointment) across sexual identity (heterosexual vs. SMW), (2) the association between ROA and past 30-days cannabis use, and (3) the interaction of sexual identity and ROA on past 30-days cannabis use.

METHOD

Participants and procedure

Participants were recruited from Amazon Mechanical Turk (MTurk) in February 2023. MTurk is a crowdsourcing platform that can be utilized by researchers to collect data from potential participants across the world. For the current study, system qualifications through MTurk were used to request only participants in the United States with a 95% approval rating (i.e., number of surveys approved by MTurk researchers divided by the number of surveys completed by the MTurk participant). Premium qualifications were also used to only recruit participants who were 18–25 years old and female. Participants were eligible for the current study if they were (1) 18–25 years old, (2) female, and (3) reported using marijuana some days (at least weekly) or every day in the past 30 days. After providing informed consent, eligible participants completed a 12–15 min survey and were compensated \$1 for participation. Five attention check items were included throughout the survey, and $n = 78$ participants (7.6%) were excluded from the final analyses due to missing two or more of the attention check items. The final sample size for this study was 949 self-identified heterosexual ($n = 666$, 70.2%) and SMW ($n = 283$, 29.8%). The Old Dominion University Institutional Review Board approved all study materials and procedures.

Materials

Participants were asked “How would you describe your sexual identity? Would you say you are”: (a) heterosexual/straight, (b) lesbian or gay, (c) bisexual, (d) pansexual, (e) queer, (f) another sexual orientation not listed, or (g) don't know/unsure. Participants were categorized as self-identified heterosexual or a sexual minority person (i.e., SMW; endorsing any other identity besides heterosexual).^{*} Past 30-days cannabis use was assessed by asking participants “In the past 30 days, on how many days did you use marijuana?” Responses ranged from 1 to 30 days. To assess ROA, participants selected all the ways they consumed cannabis in the past 30 days from a list that included: smoked a joint, smoked a blunt, smoked a bong, smoked a pipe, vaped, ate an edible, topical ointments (e.g., skin lotions), and another way not listed. Endorsement of each method of cannabis use administration was coded as yes/no. Due to low endorsement of “another way not

listed” ($n = 2$), this ROA was not included in analyses. A sum of the total number of cannabis ROA (excluding another way not listed) was also computed (possible range: 1–7).

Data analysis

Past 30-days cannabis use was normally distributed and no outliers were identified. Univariate analyzes examined differences between sexual identity (heterosexual vs. SMW) on demographic variables and each ROA. Correlation analyzes examined the association between the total number of ROA used in the past 30-days and cannabis use frequency. Independent samples *t*-tests examined differences on past 30-days cannabis use between (1) sexual identity and (2) ROA. Finally, separate analysis of covariance (ANCOVAs) models were conducted to examine the interaction of sexual identity and each ROA on past 30-days cannabis use.

RESULTS

Table 1 shows the demographic and cannabis use characteristics for the overall sample and differences between heterosexual and SMW. Among the full sample, on average, participants reported using cannabis on 12.93 ($SD = 7.47$) days and using 2.66 ($SD = 1.76$) ROA. Using more ROA was not significantly correlated with past 30-days cannabis use frequency ($r = .05$, $p = .168$). Across the sample, using a joint was the most common ROA ($n = 746$, 78.6%). Compared to heterosexual women, SMW used significantly more ROA ($M = 3.43$ vs. $M = 2.34$) and were significantly more likely to use all ROA, except for joints. Heterosexual women reported significantly more cannabis use days in the past 30 days ($M = 13.56$, $SD = 6.97$) than SMW ($M = 11.45$, $SD = 8.37$).

As shown in Table 2, independent samples *t*-test results revealed that using joints or edibles was associated with significantly greater cannabis use frequency in the past 30 days (joint: yes, $M = 13.23$, $SD = 7.20$ vs. no, $M = 11.85$, $SD = 8.33$; edible: yes, $M = 14.37$, $SD = 7.69$ vs. no, $M = 12.43$, $SD = 7.33$). Those who used blunts reported significantly fewer cannabis use days ($M = 12.29$, $SD = 7.29$) than those who did not use blunts ($M = 13.36$, $SD = 7.56$) in the past 30 days. There were no significant differences on past 30 days cannabis use for the other ROA.

ANCOVA results revealed that there was a significant interaction between sexual identity and cannabis ROA for pipe ($F [1, 941] = 6.90$, $p = .009$, $\eta^2 = 0.007$) and edibles ($F [1, 941] = 4.02$, $p = .045$, $\eta^2 = 0.004$) on past 30-days cannabis use. Simple slope analyzes revealed that SMW who used a pipe reported using cannabis on significantly more days than those who did not use a pipe ($F [1, 941] = 10.60$, $p = .001$, $\eta^2 = 0.011$; Figure 1a). There were no significant differences in past 30-days cannabis use and using a pipe among heterosexual women ($F [1, 941] = 0.07$, $p = .800$, $\eta^2 = 0.000$). Similarly, SMW who used edibles reported using cannabis on significantly more days than those who did not use edibles ($F [1, 941] = 6.44$, $p = .011$, $\eta^2 = 0.007$; Figure 1b). There were no significant differences in past 30-days cannabis use and using edibles

^{*}Although all participants were female, we use the term SMW to be consistent with prior research.

TABLE 1 Demographic and cannabis use characteristics for the overall sample and differences based on sexual identity.

	Overall N = 949	Heterosexual n = 666, 70.2%	Sexual minority n = 283, 29.8%	χ^2/t	p
Age (M, SD)	24.33 (1.33)	24.34 (1.31)	24.29 (1.37)	0.52	.302
Race/ethnicity (n, %)				19.27	<.001
NH White	873 (92.1)	629 (94.4)	244 (86.5)		
NH Black	6 (0.6)	3 (0.5)	3 (1.1)		
NH Other	5 (0.5)	1 (0.2)	4 (1.4)		
Hispanic	64 (6.8)	33 (5.0)	31 (11.0)		
Education (n, %)				35.34	<.001
High school diploma/GED	31 (3.3)	15 (2.3)	16 (5.7)		
Some college	312 (32.9)	206 (30.9)	106 (37.5)		
College degree	265 (27.9)	168 (25.2)	97 (34.3)		
Graduate school	341 (35.9)	277 (41.6)	64 (22.6)		
Relationship status (n, %)				1.14	.565
Single	205 (21.6)	142 (21.4)	63 (22.3)		
In a relationship	156 (16.5)	115 (17.3)	41 (14.5)		
Married	587 (61.9)	408 (61.4)	179 (63.3)		
Cannabis use frequency (M, SD)	12.93 (7.47)	13.56 (6.97)	11.45 (8.37)	3.72	<.001
Cannabis ROA (yes; n, %)					
Joint	746 (78.6)	530 (79.6)	216 (76.3)	1.25	.263
Pipe	476 (50.2)	292 (43.8)	184 (65.0)	35.62	<.001
Blunt	375 (39.5)	216 (32.4)	159 (56.2)	46.88	<.001
Bong	373 (39.3)	221 (33.2)	152 (53.7)	35.08	<.001
Vape	246 (25.9)	152 (22.8)	94 (33.2)	11.17	<.001
Edible	180 (19.0)	89 (13.4)	91 (32.2)	45.63	<.001
Ointment	130 (13.7)	56 (8.4)	74 (26.1)	52.87	<.001
Total ROA Used (M, SD)	2.66 (1.76)	2.34 (1.48)	3.43 (2.10)	-7.98	<.001

Note: Significant values bold for emphasis. Cannabis use frequency = number of days used cannabis in the past 30 days.

Abbreviation: ROA, route of administration.

among heterosexual women ($F [1, 941] = 0.03, p = .866, \eta^2 = 0.000$). There were no other significant interactions for other ROA and sexual identity on past 30-days cannabis use.

DISCUSSION

This was the first study to examine differences between young adult heterosexual and SMW on ROA and associations with past 30-days cannabis use. Contrary to prior research,^{4,5} heterosexual women reported greater cannabis use in the past 30 days compared to SMW. Many previous studies examining sexual identity differences on cannabis use focus on any use, as opposed to frequency of use. The current study only included cannabis users and instead examined

differences in frequency of use. Similar research examining cigarette use behavior found that SMW are more likely than heterosexual women to be current cigarette smokers, but there were no sexual identity differences on frequency or quantity of cigarettes used.²⁵ It is important for clinical assessments to inquire about frequency of substance use in addition to any past 30 days or lifetime use to obtain accurate assessments of risk behaviors. This finding may also be attributed to the sampling procedure using MTurk. Perhaps MTurk participants have different substance use patterns, relative to community or national samples. Prior research has found that MTurk participants are similar to community samples on demographic and personality characteristics (e.g., dominance, impression management).^{26,27} But differences have been detected for mental health conditions such as anxiety and depression, such that MTurk

TABLE 2 Independent samples *t*-test results of using each method of cannabis administration and past 30-days cannabis use days.

	<i>t</i>	<i>df</i>	<i>p</i>	<i>M</i>	<i>SD</i>
Joint	-2.15	287.73	.016		
Yes				13.23	7.20
No				11.85	8.33
Pipe	-1.11	929.33	.133		
Yes				13.20	7.94
No				12.66	6.96
Blunt	2.16	943	.016		
Yes				12.29	7.29
No				13.36	7.56
Bong	0.05	729.85	.482		
Yes				12.92	7.99
No				12.94	7.12
Vape	-3.53	943	<.001		
Yes				14.37	7.69
No				12.43	7.33
Edible	-0.63	943	.264		
Yes				13.25	7.71
No				12.86	7.42
Ointment	-0.43	943	.335		
Yes				13.19	7.43
No				12.89	7.48

Note: Significant values bold for emphasis.

participants have poorer mental health outcomes than community participants,²⁶ which may impact study findings. However, it should be noted that prior studies have used MTurk to examine novel research questions assessing substance use differences based on sexual identity.^{28,29}

In terms of ROA, combustible methods (i.e., joint, pipe, blunt, and bong) were the most common across all participants, which is consistent with prior research,¹² but is also alarming given the elevated health consequences related to combustible use. Joints were associated with more frequent cannabis use in the past 30 days, possibly because they are the most common ROA, as found in this study and prior research,¹² and may be the preferred method to use cannabis among users. Interestingly, those who used blunts reported fewer days of cannabis use than those who did not use blunts. Prior research has found that using blunts on more days is associated with greater cannabis use quantity and more cannabis withdrawal symptoms.¹⁴ Although our sample who reported using blunts reported less frequent use, they may use in greater quantities which could result in more cannabis consequences and a higher propensity

for addiction. When examining noncombustible ROA, the rates of vaping cannabis among the current sample were particularly high (25.9%). Cannabis vaping may be perceived as a less harmful ROA than combustible methods,³⁰ resulting in higher use of this ROA. The increasing trends of cannabis vaping are concerning though, given recent research showing an increase in EVALI-related illnesses from cannabis vaping.¹⁶ Programs that educate individuals about the harms of cannabis vaping are critical to reduce use and prevent long-term health consequences among young adults.

SMW were more likely than heterosexual women to use all ROA except for joints and used more ROA. Targeted cannabis marketing toward the LGBTQ+ community may explain the higher prevalence of each ROA. Cannabis marketing is often for nontraditional cannabis products (i.e., ROA outside of joints), which may partially explain the broader variety of ROA among SMW. There is a long history for marketing addictive substances directly to minority populations. Historically, the tobacco industry disproportionately targeted minority communities, including LGBTQ+ individuals.³¹ More recently, Anheuser-Busch has been in the news for hiring a transgender influencer for a sponsored social media post to rollout a pride themed bud light can.³² Most Pride events are not smoke-free and often have alcohol sponsors,³³ inadvertently exposing and seemingly encouraging LGBTQ+ individuals to use tobacco and alcohol. Similar marketing and sponsorship tactics toward the LGBTQ+ community may be adapted by the cannabis industry. For instance, it is common for cannabis companies to market products to the LGBTQ+ community in June, which is often referred to as Pride month. LGBTQ+ individuals often experience discrimination due to their sexual identity⁶ so marketing strategies that feel inclusive to them may be perceived as positive. Indeed, qualitative research among LGBTQ+ young adult tobacco smokers has shown that they view the targeted tobacco marketing strategies to the sexual minority community as a positive experience because they feel accepted and “seen” by a large corporation.³⁴ Further, some cannabis companies pledge donations to LGBTQ+ initiatives and charities during Pride month. Although donations to these organizations and supporting the LGBTQ+ community is *exceedingly important* and necessary, companies may be luring customers with these prosocial behaviors to make a profit for themselves and persuade sexual minority consumers to use their products, thereby enhancing health inequities among young adult SMW.

Findings from the current study identified differences between using a pipe and edibles on past 30-days cannabis use, based on sexual identity. Specifically, SMW who used a pipe or edibles reported more cannabis use days in the past 30 days than SMW who did not; but there were no differences for heterosexual women. Perhaps SMW are more likely to use pipes or edibles in social situations, which increases the frequency of use. Because SMW may experience minority stressors,⁶ they may seek out social situations to develop relationships with other SMW who have similar experiences. However, prior research has shown that SMW report using cannabis most often with other SMW than with other groups (e.g., sexual minority men, heterosexual women, heterosexual men), and using

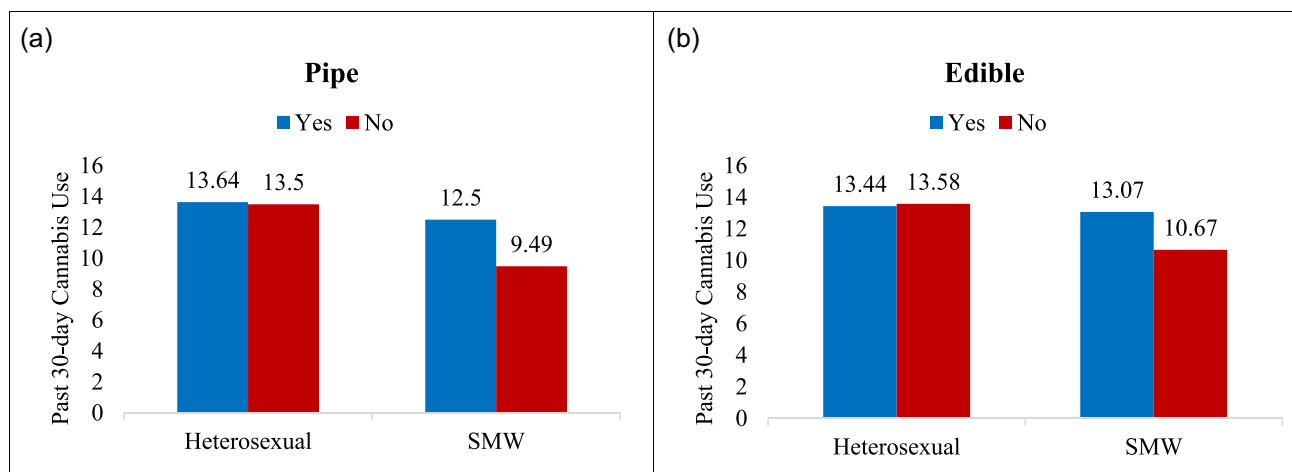


FIGURE 1 Differences between pipe and edible use on past 30-days cannabis use frequency based on sexual identity. SMW, sexual minority women.

cannabis with other SMW is associated with more problematic use 6-months later.³⁵ As stated previously, the marketing of cannabis products may entice some SMW to use specific cannabis ROA. Pipes can be manufactured to come in various colors and designs, including depicting the Pride flag. Similar designs for edible packaging are often used for products specific to the LGBTQ+ community. Thus, SMW may be using pipes and edibles to administer cannabis in social situations because the marketing of these products is appealing to them and may serve as a way to foster social connections with other SMW. While understanding the contextual elements of cannabis use among SMW is in its infancy (e.g., who they are with, location), the ROA is another important correlate of use that should be considered.

Limitations

Several study limitations should be noted. First, data for this study are cross-sectional and causal inferences between ROA and subsequent cannabis use are unknown. Second, all SMW were grouped together, potentially masking important differences between subgroups of SMW (e.g., lesbian vs. bisexual). Future studies should collect larger samples of SMW to make comparisons between sexual minority identities. Third, the sample was predominantly non-Hispanic White. Comparisons based on race/ethnicity were not examined. It is critical to examine the intersection of race/ethnicity and sexual identity on cannabis use and ROA, to identify other health disparity groups at risk for negative cannabis-related consequences. Fourth, data was collected from MTurk which may limit generalizability to the broader population and literature. Fifth, cannabis quantity and potency were not measured. Although subjective, asking participants to report how many hours they are high could be one way to capture cannabis quantity. Unfortunately, the current study did not examine this potential quantity variable. Developing valid and reliable measures to quantify the amount and potency of cannabis a person uses is an area that is urgently needed as the rates of cannabis use continue to increase.

Conclusions

This was the first study to examine differences based on sexual identity and ROA, and the interactive effect on past 30-days cannabis use. Findings further our knowledge about how young adult women are using cannabis, and highlight potential correlates based on ROA that contribute to the health disparities observed among SMW. Developing prevention and intervention programs that focus on informing individuals of the harms of various ROA may help lower cannabis use rates. Further, it is imperative that policies are developed to regulate the marketing and sale of cannabis products to sexual minority communities. The proliferation of cannabis and the ROA are rapidly evolving. As such, public health initiatives, including policies, are critical to prevent serious physical and behavioral health consequences of cannabis, particularly among those at highest risk of use such as SMW.

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CONFLICT OF INTEREST STATEMENT

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this paper.

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