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Use of multiple tobacco products in a national sample of persons enrolled in addiction treatment



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ABSTRACT

Objective: To explore use of tobacco products in relationship to marketing exposure among persons in addiction treatment.

Method: A random sample of treatment programs was drawn from the National Institute on Drug Abuse (NIDA) Clinical Trials Network (CTN). Participants in each program completed surveys concerning use of tobacco products (N = 1113). Exposure to tobacco marketing and counter-marketing, advertising receptivity, and perceived health risks of smoking were tested for their association with use of multiple tobacco products.

Results: Prevalence of combustible cigarette use was 77.9%. Weekly or greater use of other products was: e-cigarettes (17.7%), little filtered cigars (8.6%), smokeless tobacco (5.2%), and standard cigars (4.6%) with 24.4% using multiple tobacco products. Compared to single product users, multiple product users smoked more cigarettes per day (OR = 1.03, 95% CI 1.01–1.05, $p < 0.001$), were more likely to have tried to quit (OR = 1.41, 95% CI 1.02–1.96, $p = 0.041$), reported greater daily exposure to advertising for products other than combustible cigarettes (OR = 1.93, CI 1.35–2.75, $p < 0.001$), and greater daily exposure to tobacco counter-marketing (OR = 1.70, 95% CI: 1.09–2.63, $p = 0.019$).

Conclusion: Heavier smokers and those trying to quit may be more likely to use e-cigarettes, little filtered cigars, or smokeless tobacco and have greater susceptibility to their advertising. This highlights the importance of regulating advertising related to smoking cessation as their effectiveness for this purpose has not been demonstrated.

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1. Introduction

The Family Smoking Prevention and Tobacco Control Act (TCA) wrested control of tobacco products from corporations and assigned it to an agency with the charge to protect public health. Since the TCA became law in June 2009, the Food and Drug Administration (FDA) banned most cigarette flavorings, restricted sale of tobacco products to children and adolescents, banned tobacco advertising with misleading terms (National Institutes of Health, 2012), and now plans to regulate e-cigarettes (U.S. Department of Health and Human Services, 2016).

Tobacco control efforts in the U.S. have driven smoking prevalence to 16.8% as of 2014 in the United States, a 20.9% decrease over

the last decade (Jamal et al., 2015). Yet these strategies have left prevalence high in subgroups with mental health and substance use disorders (Gudysh et al., 2011; Lasser et al., 2000). While tobacco company advertising, incentives and product development have targeted vulnerable populations (Apollonio and Malone, 2005), tobacco control strategies have not (Gudysh, 2012). The FDA has recognized the intersection of tobacco use, marketing, and regulation in vulnerable populations, and called for research in these groups to inform its regulatory efforts.

Persons with substance abuse and dependence are vulnerable to tobacco use. As a group they smoke at higher rates (Kalman et al., 2005; McClure et al., 2014), smoke more heavily than the general population (Hughes, 2002; Ward et al., 2012), and are less successful in quitting than non-substance abusers (Drobes, 2002; Ferron et al., 2011; Stein et al., 2013). Alcohol and drug dependent persons die from smoking-related causes more frequently than from drug or alcohol-related causes (Bandiera et al., 2015; Hser et al., 1994;

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Hurt et al., 1996). Cigarette and alcohol consumption may be mutually reinforcing, with possible behavioral (Ait-Daoud et al., 2006, 2005; Sayette, 2002) and genetic components (Littleton and Little, 2002; Schlaepfer et al., 2008). Although most persons in addiction treatment also smoke, many are interested in quitting smoking (Saxon et al., 1997), and two studies have reported 10% quit rates for persons in addiction treatment even in the absence of cessation intervention (Chun et al., 2009; Kohn et al., 2003). However, even in the context of robust tobacco control strategies (Walsh and Gordon, 1986), the smoking prevalence among persons in addiction treatment has shown little change over time (Gyu'dish et al., 2011, 2015b), highlighting the continued need to address tobacco use in this population.

While there are now developed literatures concerning smoking (Gyu'dish et al., 2015a, 2011) and smoking cessation among persons in addiction treatment (Prochaska et al., 2004; Thurgood et al., 2016), little is known about their use of other tobacco products. For example, among 96 papers included in reviews of smoking prevalence in addiction treatment (Gyu'dish et al., 2015a, 2011), only 7 papers reported on use of tobacco products other than cigarettes (Aubin et al., 1999; Basu et al., 2012; Ellingstad et al., 1999; Hurt et al., 1996; Patten et al., 2003; Richter et al., 2001; Rooban et al., 2009). Recently, e-cigarette use has been reported in addiction treatment samples (Peters et al., 2015; Stein et al., 2015). Similarly, there are few reports concerning the concurrent use of multiple tobacco products, or factors that may be associated with use of multiple products. One study found that 10.6% of US adults used multiple tobacco products, and that younger age, male gender, never having been married, and having tried to quit smoking were associated with multiple product use (Lee et al., 2014).

Based on their association with use of combustible cigarettes, a number of factors may also be associated with use of more than one tobacco product. Age, gender, education and race/ethnicity are associated with smoking prevalence in the general population (Centers for Disease Control and Prevention, 2015b; Garrett et al., 2011). Among those in drug treatment, smoking is more prevalent among opioid users (Stark and Campbell, 1993) and number of cigarettes per day (CPD) and use of tobacco cessation services have been associated with making a quit attempt (Martinez et al., 2015). Advertising receptivity predicts smoking initiation and maintenance (Henriksen et al., 2010), and advertising exposure has been associated with smoking initiation (Robertson et al., 2015). Counter-marketing campaigns to prevent smoking initiation and promote quitting can be successful (Davis et al., 2008), and messages focusing on negative health effects appear effective in increasing awareness of risks and facilitating quitting behavior (Durkin et al., 2012). While effects of tobacco advertising, counter-marketing, and risk perception have been explored in youth populations (Halpern-Felsher et al., 2004; Henriksen et al., 2010; Paynter and Edwards, 2009), they are little explored among adults engaged in addiction treatment.

This report describes findings from a national sample of persons enrolled in addiction treatment concerning their use of multiple tobacco products. We assessed factors associated with use of multiple tobacco products while controlling for demographic characteristics.

2. Materials and methods

2.1. Sampling design

Addiction treatment programs were recruited in collaboration with the National Institute on Drug Abuse (NIDA) Clinical Trials Network (CTN), a national network of research centers or “nodes,” where each node included one or more university partners and

a number of addiction treatment programs (National Institute on Drug Abuse, n.d.). There were 13 CTN nodes at the time the research was conducted. However, since its creation in 2000, the organizational membership of the CTN changes frequently, with both nodes and treatment programs entering and exiting with changing patterns of Federal funding and reciprocal willingness to continue to participate in the network. The CTN is dedicated to the conduct of clinical trials designed to improve addiction treatment (Nunes, 2011) and was used for this research because it offers a national network of addiction treatment programs that are research experienced, and where challenges of field research were less likely to interfere with implementation. The population of programs used in the current study was the 2013 list of CTN-affiliated treatment programs (N = 166) identified in prior research (Roman et al., 2010).

2.2. Program selection

Eligible for inclusion were CTN-affiliated programs that were: a) publicly-funded – defined as those receiving over 51% of their revenue from federal/state governmental sources; b) moderate or large in size – having at least 60 active patients, so that recruitment of the target 40 patients per program could be accomplished during a 1–3 day site visit; and c) willing to assign a staff liaison to coordinate data collection with the study team. Excluded were: a) privately funded programs; b) Veterans Administration (VA) programs; c) adolescent programs; and d) criminal justice or hospital-based programs that would require local IRB approval in addition to approval from the lead university. VA programs were excluded because they had standard policies on tobacco assessment and treatment, which differ from programs sampled from non-VA systems. Meeting eligibility criteria were 48 programs. The data collection plan was for a sample of 25 programs and, to allow for refusals, we drew a random sample of 33 programs stratified by program type. In this sample were outpatient (n = 15), residential (n = 13) and methadone (n = 5) programs.

2.3. Program recruitment

The research team contacted the coordinator of each CTN node where selected programs were affiliated, and each “node coordinator” contacted programs in their node to assess interest. At this stage, six programs were no longer active in the CTN, two programs declined, and one was not needed to meet patient recruitment goals. Remaining in the sample were 9 outpatient, 10 residential and 5 methadone programs.

The research team then scheduled a phone meeting with each Program Director, in which the study was discussed the program was recruited. All programs contacted at this stage agreed to participate. In three instances Program Directors preferred that the study occur in a different program, within the same agency, than the program originally selected. This resulted in changes to the type of program where data were collected. One program changed from residential to methadone, one changed from outpatient to methadone, and one changed from outpatient to residential. The final sample included 7 outpatient, 10 residential, and 7 methadone programs. Programs were from 13 States (California, Ohio, Texas, Hawaii, Florida, Oregon, North Carolina, Pennsylvania, Vermont, Connecticut, South Carolina, New York, West Virginia), with at least 1 program from each of the 4 US census regions.

2.4. Participants

Clients in each program (including both smokers and non-smokers) were eligible to participate if they had been in treatment for at least 10 days. This ensured that they had time to become aware of tobacco policies and services in their program. To partic-

ipate, clients had to be present in the program on the day of the site visit. In outpatient and methadone programs this procedure resulted in a systematic sample, while in residential programs it yielded a census sample. In each program, the director reported current program census at the time of the survey. Combined capacity across the 24 programs was estimated at 6801 persons. Methadone programs ranged in size from 200 to 1000, outpatient program from 70 to 700, and residential programs from 40 to 125. Our sample of 1113 represents 16.4% of the total active patients in participating programs. As data collection occurred in each program for 1–3 days, the maximum active patients seen would have been 3649 (0.6×6081), and in that case the sample represents 30% of all active patients in participating programs.

2.5. Procedures

The research team visited each site between May 2014 and February 2015. One staff member in each program served as the study liaison and coordinated the site visit with the research team. At all sites, participants completed the surveys in groups of up to six, determined by the number of iPads available. In residential programs, the staff liaison used a sign-up sheet to recruit participants in multiple time slots during the site visit. The research team explained the study to assembled clients and completed informed consent procedures. In methadone clinics the team recruited clients during morning dosing hours. In outpatient programs the team visited day or evening groups with high concentrations of clients, and invited study participants either at the beginning or end of the clinical group session. No record was made of persons who had no interest in the study, and field staff reported that participants sometimes declined due to lack of time to complete the survey. Among those who began the consent process, none declined to participate. Site visits were completed in one day for residential and methadone clinics, and 2–3 days for outpatient clinics. The number of participants recruited per clinic ranged from 28 to 53, with a median of 50. Each respondent received a \$20 gift card, and each program received a \$2000 incentive following the site visit. Procedures were approved by the University of California, San Francisco, Institutional Review Board.

2.6. Measures

2.6.1. Demographic characteristics and use of tobacco products. Demographic characteristics included age, gender, education, race/ethnicity, and treatment type (outpatient, residential, methadone). Current smokers were defined as having smoked more than 100 cigarettes in their lifetime and also reporting being a current smoker. Current smokers reported number of cigarettes per day (CPD), number of serious quit attempts (for at least 24 h) made in the past year, and lifetime use of nicotine replacement therapy (NRT: patch, gum, lozenge, inhaler, or nasal spray).

With pictures of products embedded in the survey, respondents were asked whether they had ever used smokeless tobacco, standard cigars, little filtered cigars (LFCs), or e-cigarettes/vape pens. For each product, those reporting lifetime use were asked whether they had used the product in the past 30 days and, if so, the frequency of use (daily, 2–3 times a week, weekly, or less than once a week). Tobacco product use items were adapted from the Population Assessment of Tobacco and Health (PATH) survey (Ambrose et al., 2015).

All current smokers were classified as “users” of combustible cigarettes. Because use of other tobacco products (smokeless tobacco, cigars, LFCs, e-cigarettes) may be infrequent or experimental, we defined “current use” as having used the product at least weekly in the past 30 days. Respondents who reported current use of one product were classified as single product users, while

those who used more than one product were classified as multiple product users.

2.6.2. Exposure to tobacco advertising and counter-marketing. Receptivity to tobacco advertising was measured using the 4 item Pierce advertising scale, a measure shown to be associated with progression of smoking in adolescents (Pierce et al., 1998). Questions assessed if participants had received a tobacco promotional item (e.g., cap or t-shirt), willingness to use an item, brand of a favorite cigarette advertisement, and brand of cigarette the respondent has seen advertised the most. Persons who had either received or were willing to use a promotional item were classified as highly receptive to tobacco advertising. While Pierce et al. classified individuals as having low or intermediate classifications based on two questions (brand of favorite advertisement and brand advertised the most), we found only 5% of respondents were in the low category, and collapsed low and moderate into one category.

As the Pierce advertising measure is specific to cigarettes, respondents were also asked whether they had seen advertisements in the past 30 days, and how often they had seen advertisements (0, <weekly, weekly, daily) for each of three other tobacco products (smokeless tobacco, e-cigarettes, LFCs). Among youth, current and future cigarette smoking are associated with marketing exposure (Braverman and Aaro, 2004; Unger et al., 2003).

Exposure to tobacco counter-marketing was measured using the FDA Real Cost campaign, launched in 2014 and directed toward youth (Food and Drug Administration, 2015). Using frame shots from television commercials to support understanding, participants were asked whether they had seen Real Cost ads in the past 30 days, and how often they had seen these ads (0, <weekly, weekly, daily).

2.6.3. Perceived health risks of smoking. Respondents received a standard scenario of a one pack per day smoker who had smoked for 15 years, and estimated the chance (0–100%) that the smoker would: get lung cancer, have trouble catching his breath, have a heart attack, get mouth or lip cancer. For each participant, the mean of the four risk percentages represented the perceived health risks of smoking. Adolescents discriminate different levels of risk between different types of smokers (Rubinstein et al., 2003) and estimate risks differently based on their own smoking experience (Halpern-Felsher et al., 2004).

2.7. Data analysis

We report demographic characteristics for the total sample ($N = 1113$), followed by the proportion of participants who reported use of each individual tobacco product, and the proportion who reported use of multiple tobacco products. Second, we compare single tobacco product users to multiple product users on smoking behavior measures (cigarettes per day, quit attempts in the past year, and lifetime use of nicotine replacement therapy), on the marketing and counter-marketing exposure measures, and on the perceived health risk measure. Third, we assessed factors associated with use of multiple tobacco products using multivariate logistic regression model, and controlling for demographic characteristics, type of program where recruited, and nesting of patients within program. As rates of missing data were very low, the multivariate model used complete case analysis in which 885 of 915 cases were included. Generalized estimating equation (GEE) methods were applied for correlated data. The GEE method was conducted in the GENMOD procedure with a logit link function and repeated statement. The variance inflation factor (VIF) and tolerance coeffi-

Table 1
Demographic Characteristics and Use of Tobacco Products among Persons Enrolled in Addiction Treatment (N = 1113).

Variable	Mean (SD) or n (%)
Age	38.3 (11.74)
Gender	
Male	558 (50.2%)
Female	549 (49.4%)
Other	5 (0.5%)
Education	
Less than high school/GED	269 (24.2%)
High school/GED	363 (32.6%)
More than high school/GED	480 (43.2%)
Race/Ethnicity	
Hispanic	132 (11.9%)
Black/African American	211 (19.0%)
White	615 (55.3%)
American Indian/Alaska Native	54 (4.9%)
Asian/Pacific Islander	17 (1.5%)
Other/Multiple	83 (7.5%)
Treatment Type	
Outpatient	344 (30.9%)
Residential	423 (38.0%)
Methadone	346 (31.1%)
Weekly Use of Tobacco Products ^{a,b}	
Cigarettes	867 (77.9%)
e-Cigarettes	197 (17.7%)
Smokeless Tobacco	58 (5.2%)
Little Filtered Cigars	96 (8.6%)
Cigars	51 (4.6%)
Weekly use of at least one product	915 (82.2%)
Multiple Product Use ^a	
No product	198 (17.8%)
One product only	644 (57.9%)
Multiple products	271 (24.4%)

^a Self-report use of tobacco products at least weekly in the past 30 days.

^b Percentages add to more than 100% due to multiple product use.

cient were used to assess multi-collinearity. All statistical analyses were performed using SAS 9.3.

3. Results

Participants had a mean age of 38.3 (SD = 11.74), half (49.4%) were women, and most (75.8%) had a high school education or higher. Participants were 55.3% White, 19% African American, and 11.9% Hispanic (Table 1). Participants were nearly evenly drawn

Table 2
Tobacco Use Measures among Current Tobacco Users (N = 915).

	Mean (SD) or n (%)			P-value
	Total(N = 915)	One Tobacco Product(N = 644)	Multiple Tobacco Products(N = 271)	
Cigarettes per Day (CPD)	12.4 (8.28)	11.8 (7.82)	13.7 (9.18)	0.002
Any quit attempts in past year	428 (46.8%)	291 (45.2%)	137 (50.6%)	0.137
Ever used nicotine replacement therapy (NRT)	445 (49.2%)	296 (46.6%)	149 (55.2%)	0.018
Pierce Advertising Receptivity				0.035
High	612 (66.9%)	417 (64.8%)	195 (72.0%)	
Low/Moderate	303 (33.1%)	227 (35.2%)	76 (28.0%)	
Exposure to advertising of other tobacco products				<0.001
No	194 (21.2%)	157 (24.4%)	37 (13.7%)	
<Weekly	180 (19.7%)	129 (20.0%)	51 (18.8%)	
Weekly	246 (26.9%)	174 (27.0%)	72 (26.6%)	
Daily	295 (32.2%)	184 (28.6%)	111 (41.0%)	
Exposure to Real Cost counter-marketing campaign				0.001
No	439 (48.1%)	321 (49.9%)	118 (43.7%)	
<Weekly	171 (18.7%)	127 (19.8%)	44 (16.3%)	
Weekly	165 (18.1%)	117 (18.2%)	48 (17.8%)	
Daily	138 (15.1%)	78 (12.1%)	60 (22.2%)	
Perceived health risks of smoking	59.4 (20.25)	59.5 (20.08)	59.1 (20.67)	0.785

The bold values are statistically significant values (p values < 0.05).

from each of the three treatment types, although somewhat more (38%) were recruited from residential programs. Many (77.9%) reported current weekly use of combustible cigarettes, and the next most frequently used product was e-cigarettes (17.7%). Most (82.2%) used at least one tobacco product on a weekly basis in the past month, and 24.4% used multiple products.

Table 2 compares participants who used one tobacco product to those using multiple products on three measures of smoking behavior (CPD, quit attempts, use of NRT), and on the marketing/counter-marketing and risk perception measures. Compared to single product users, multiple product users had higher mean CPD (13.7 vs. 11.8, $p = 0.002$) and more often reported any lifetime use of NRT (55.2% vs. 46.6%, $p = 0.018$). Compared to single product users, multiple product users were also more likely to have high receptivity to tobacco advertising, reported higher daily exposure to advertising of tobacco products other than combustible cigarettes, and more often reported high daily exposure to the FDA Real Cost counter-marketing campaign (See Table 2).

Results of the multivariate logistic regression model of single vs. multiple product use are summarized in Table 3. Compared to single product users, multiple product users had higher CPD (OR = 1.03, 95% CI: 1.01–1.05, $p < 0.001$), greater odds of having made a serious smoking quit attempt (OR = 1.41, 95% CI: 1.02–1.96, $p = 0.041$), and more often reported high exposure to daily advertising for products other than combustible cigarettes (OR = 1.93, 95% CI: 1.35–2.75, $p < 0.001$). Multiple product users also reported greater daily exposure to the Real Cost counter-marketing campaign (OR = 1.70, 95% CI: 1.09–2.63, $p = 0.019$). Age, entered as a control variable, showed that younger age was associated with use of multiple products (OR = 0.97, CI 0.95–0.98, $p < 0.001$). Multicollinearity was evaluated using VIF and tolerance coefficient. For the variables in the model, the VIF are small (<1.13) and the tolerance coefficients are greater than 0.88. These indicators suggest that multicollinearity does not threaten the model.

4. Discussion

The rate of combustible cigarette smoking in this study (77.9%) is comparable to the median annual smoking prevalence rate (76.3%) reported in a prior literature review (Guydish et al., 2011). This smoking rate is slightly higher than estimates derived from National Survey on Drug Use and Health data from 2006 to 2011, which ranged from 72.6% to 74.5% (Guydish et al., 2015b). Nevertheless, these data show high and unremitting smoking prevalence

Table 3
Multiple Logistic Regression Analysis of Factors Associated With Use of Multiple Tobacco Products among Current Tobacco Users^a.

Variable	Adjusted OR (95%CI)	p
Age	0.97 (0.95–0.98)	<0.001
Gender		
Male (Ref)	1	
Female	0.87 (0.58–1.28)	0.473
Education		
More than high school/GED (Ref)	1	
Less than high school/GED	1.09 (0.69–1.72)	0.725
High school/GED	0.93 (0.64–1.35)	0.702
Race		
Hispanic (Ref)	1	
Black/African American	0.97 (0.49–1.91)	0.925
White	0.92 (0.48–1.78)	0.812
Other	0.67 (0.30–1.51)	0.336
Program type		
Residential (Ref)	1	
Outpatient	1.05 (0.63–1.75)	0.837
Methadone	1.08 (0.61–1.91)	0.803
Cigarettes per Day (CPD)	1.03 (1.01–1.05)	<0.001
Any quit attempts in past year		
No (Ref)	1	
Yes	1.41 (1.02–1.96)	0.041
Ever used nicotine replacement therapy (NRT)		
No (Ref)	1	
Yes	1.44 (0.96–2.15)	0.076
Pierce Advertising Receptivity		
Low/Moderate (Ref)	1	
High	1.40 (0.92–2.14)	0.114
Exposure to advertising of other tobacco products		
No (Ref)	1	
<Weekly	1.53 (0.96–2.44)	0.077
Weekly	1.41 (0.82–2.44)	0.213
Daily	1.93 (1.35–2.75)	<0.001
Exposure to Real Cost counter-marketing campaign		
No (Ref)	1	
<Weekly	0.88 (0.57–1.38)	0.586
Weekly	0.91 (0.54–1.56)	0.738
Daily	1.70 (1.09–2.63)	0.019
Perceived health risk of smoking	1.00 (0.99–1.00)	0.244

The bold values are statistically significant values (p values < 0.05).

^a The multiple logistic regression model included all variables listed in the table, and controlled for nesting of participants within program. As rates of missing data were very low, the multivariate model used complete case analysis in which 885 of 915 cases were included.

among persons enrolled in addiction treatment. The first consideration, for addiction treatment, tobacco control, and FDA regulatory authority, is that tobacco use and associated health effects are concentrated in this population.

Most frequently used among other tobacco products were e-cigarettes (17.7%), similar to 17% reported among addiction treatment outpatients in Baltimore (Peters et al., 2015) and lower than the 33.8% reported among opiate dependent patients in Massachusetts (Stein et al., 2015). Our definition of current use was weekly or greater in the past month, while both Peters et al. and Stein et al. defined current use as any use in the past month. Use of smokeless tobacco (5.2%) and cigars (4.6%) in this sample were close to US adult population figures of 3.6% and 5.4%, respectively (U.S. Department of Health and Human Services, 2014). Prevalence of LFC use is not broken out in CDC reports (Corey et al., 2014), so a direct comparison with population data is not possible. However use of LFCs by 8.6% in the current sample exceeds the national prevalence of cigar use (4.6%), and suggests a high rate of LFC use in this population. LFCs capture only 4% of the cigar market, however the use of flavorings in these products and reduced taxation may make them appealing to low income smokers (Centers for

Disease Control and Prevention, 2015a). Most users of smokeless, LFC and cigar products in the current sample also used combustible cigarettes (79.3%, 91.7%, 92.2%, respectively).

While e-cigarettes may help some individuals quit smoking, a recent review concluded that use of e-cigarettes was associated with lower odds of quitting smoking (Kalkhoran and Glantz, 2016). Nevertheless, e-cigarette advertisements often claim that these products are helpful in quitting smoking (Grana and Ling, 2014). As with e-cigarettes, manufacturers of smokeless tobacco have made claims that these products may help reduce or quit smoking (Mejia and Ling, 2010). Regulatory strategies concerning e-cigarettes, smokeless tobacco, cigars and LFCs should limit advertising and product packaging to avoid claims that they are helpful to stop smoking, or require statements that these products have not been shown effective in smoking cessation.

A substantial proportion of this sample (24.4%) used multiple tobacco products. When controlling for demographic variables and program type, persons with higher CPD and more past year quit attempts were more likely to use multiple tobacco products. This suggests that multiple product users had both greater nicotine addiction and greater interest in quitting, and is consistent with findings that persons intending to quit smoking are more likely to use other tobacco products (Popova and Ling, 2013), and multiple tobacco products (Lee et al., 2014). Daily exposure to advertising for products other than cigarettes was also associated with use of multiple products. This finding is consistent with literature indicating the effectiveness of tobacco advertising (e.g., Henriksen et al., 2010; Paynter and Edwards, 2009) although causal inferences cannot be drawn. There may exist a reciprocal effect, in which advertising encourages multiple product use, and multiple product users pay more attention to tobacco advertising. Regardless, if industry advertising encourages multiple product use, it may increase nicotine addiction, by promoting the use of non-combustible products where smoking is banned and make it more difficult to quit. At the same time, daily exposure to the Real Cost counter-marketing campaign was also associated use of multiple products. This association is not previously reported and warrants replication, but it may be that more heavily dependent tobacco users who are interested in quitting also attend more to counter-marketing messages in the environment.

Generalizability is a potential study limitation. We selected a random sample of addiction treatment programs within the NIDA CTN. We encountered challenges in recruiting randomly selected programs including some programs that were no longer active in the CTN, or that declined participation, and cases where the program director suggested conducting the study in a different program within the same agency. CTN programs, and patients in those programs, may also differ from non-CTN programs and patients. A comparison of methadone programs within and outside the CTN found that CTN programs were more likely to be non-profit programs, to have more employees and a higher patient census, and to have patient populations that were more often on Medicaid, unemployed, and involved in the criminal justice system (Ducharme and Roman, 2009). In a comparison of participants enrolled in CTN clinical trials to those receiving treatment in usual care settings, those enrolled in a CTN clinical trials were more likely to have full-time jobs and higher levels of education (Susukida et al., 2016). For these reason the sample may not be nationally representative. As an additional limitation, these cross-sectional data do not permit observation of change over time or causal attribution.

Rates of smoking and other tobacco use reported in this study may adequately represent publicly-funded non-profit programs serving uninsured patients or patients covered by Medicaid. However, private, for-profit addiction treatment programs that serve employed and insured patients would likely have lower rates of smoking and other tobacco use. Moreover, patients in this

sample were drawn from outpatient (30.9%), residential (38%) and methadone maintenance (31.1%) programs, while patients in addiction treatment programs nationally are distributed differently (59.6%, 7.8%, 26.4%, respectively; [Substance Abuse and Mental Health Services Administration, 2014](#)). The current sample over-represents residential patients, where smoking rates tend to be higher as compared to outpatients ([Guydish et al., 2015b](#)). While programs meeting inclusion criteria were randomly selected, patients within programs represent either a census sample (in residential programs) or a systematic sample (in outpatient and methadone programs). Regarding measurement, the FDA Real Cost campaign was designed for youth. The CDC Tips from Former Smokers campaign was designed for adult smokers ([Centers for Disease Control and Prevention, 2012](#)) and may be a more suitable measure of counter-marketing exposure among adults.

Based on a national sample of persons enrolled in addiction treatment, the prevalence of combustible cigarette smoking was found to be high and, as a corollary, health and economic costs of smoking are concentrated in this population. The rate of multiple product use in this addiction treatment sample was 24.4%, compared to 10.6% in the general population ([Lee et al., 2014](#)), and appears to be associated with interest in quitting smoking. While other tobacco products are often marketed as ways to reduce health risks or quit smoking, most multiple product users continued to smoke combustible cigarettes. An estimated 4 million persons receive some form of addiction treatment each year ([Substance Abuse and Mental Health Services Administration, 2009](#)) and, using an 82% rate of tobacco use, 3.2 million of those are tobacco users. Intervention with this number of users, whether through policy, regulatory or individual tobacco cessation intervention, can meaningfully reduce health and economic costs of tobacco use at the population level.

Conflict of interest

No conflict declared.

Contributors

Joseph Guydish conceived the study, had oversight of all implementation and analysis and drafted the paper. Barbara Tajima developed the survey and executed data collection. Sowmya Pramod and Thao Le managed data, conducted analyses presented, and contributed to data interpretation. Noah Gubner contributed to writing and interpretation particularly related to use of electronic cigarettes, and Barbara Campbell contributed to writing and interpretation in the areas of tobacco marketing and counter-marketing exposure. Paul Roman contributed to development of program sampling procedures, drew the sample of programs using data previously collected by his research team, and reviewed and revised the manuscript. All authors have read and approved of the submission of this manuscript to *Drug and Alcohol Dependence*.

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