



## E-cigarette use and beliefs among adult smokers with substance use disorders

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### ABSTRACT

**Background:** We explored characteristics and beliefs associated with e-cigarette use patterns among cigarette smokers requiring inpatient detoxification for opioid and/or alcohol use disorder(s).

**Methods:** Adult cigarette smokers ( $\geq 18$  years), admitted to inpatient detoxification for alcohol and/or opioid use disorder(s) in a safety-net tertiary referral center in New York City were surveyed in 2015 ( $n = 158$ ). Descriptive statistics (proportions) were used to assess for demographic, clinical diagnosis, cigarette smoking patterns (exclusive and dual use of e-cigarettes). Chi-square, *t*-test statistics, and logistic regression models were used.

**Results:** Among our sample of combustible cigarette users, 13.9% ( $n = 22$ ) reported dual use with electronic cigarettes. Dual use did not differ by demographic or clinical variables. Compared to exclusive smokers, dual users were more likely to have tried to quit in the past year (Adjusted Odds ratio = 8.59; CI: 2.58, 28.35;  $p < 0.001$ ). Dual smokers had significantly higher mean ratings perceiving that e-cigarettes can *help people quit smoking* compared to exclusive smokers ( $M = 3.7$ ,  $SD = \pm 1.4$  vs.  $M = 2.7$ ,  $SD = \pm 1.5$ ,  $p = 0.002$ ) respectively. Dual users also preferred e-cigarettes over nicotine patches /gum for quitting ( $M = 3.7$ ,  $SD = \pm 1.7$  vs.  $M = 2.6$ ,  $SD = \pm 1.6$ ,  $p = 0.005$ ).

**Conclusions:** E-cigarette use seems to be appealing to a small proportion of cigarette smokers with SUD. Although, dual smokers seem to use e-cigarettes for its cessation premise, they don't appear to be actively seeking to quit. E-cigarettes may offer a more effective method for harm reduction, further evaluation of incorporating it within smoking cessation protocols among patients in addiction treatment is needed.

### 1. Introduction

Tobacco use is the leading cause of premature death in the United States (US Department of Health Human Services, 2014). Most smokers want to quit and have made multiple quit attempts, but the majority fail due to their dependence on nicotine and behavioral cues that reinforce their smoking behavior (Buchhalter, Acosta, Evans, Breland, & Eissenberg, 2005). Adults with alcohol use disorder (AUD) and/or opioid use disorder (OUD) carry a disproportionately high burden from smoking compared to the general population. In addition, illicit substance and alcohol use is highly correlated with continued smoking and failure to

quit (McKee & Weinberger, 2013; Baca & Yahne, 2009; Guydish et al., 2011). No study to date has found long-term success for prolonged smoking cessation (more than 12 months) in people with substance use disorders (Ronckers, Groot, & Ament, 2005; Stead, Perera, Bullen, & Mant, 2012). This may be attributed to conventional cessation medications that do not replace the behavioral ritual associated with cigarette use, nor deliver nicotine as rapidly as cigarettes (Le Houezec, 2003; Walker et al., 2011). Rates of successful smoking cessation for individuals suffering from AUD and OUD is low despite the fact that smoking abstinence can improve substance use disorder treatment outcome and reduce morbidity and mortality among this vulnerable

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population (Baca & Yahne, 2009). Limited adoption of smoking cessation counseling and pharmacotherapy (e.g., nicotine replacement therapies) in addiction treatment may be due to the perceived lack of importance by providers in addiction treatment settings, limited staff training, lack of highly effective interventions among this population and insufficient financial reimbursement for the delivery of FDA approved cessation medications and cessation interventions (Baca & Yahne, 2009; Knudsen, Studts, Boyd, & Roman, 2010).

E-cigarettes use has been increasing in the US (Pearson, Richardson, Niaura, Vallone, & Abrams, 2012). Preliminary evidence suggests that e-cigarettes could be beneficial as a smoking cessation aid. Additionally, there is a growing body of literature supporting e-cigarette as a harm reduction strategy compared to combustible cigarette smoking (Tan & Bigman, 2014). However, beliefs and use of e-cigarettes among smokers with substance use disorders (SUDs) remains limited (Guydish et al., 2011; Peters, Harrell, Hendricks, Kevin, & O'grady, Wallace B Pickworth, and Frank J Vocci., 2015). The goal of this study was to explore patient perceptions and experiences with e-cigarette use and its potential role in reducing combustible cigarette use among adult smokers requiring inpatient detoxification for opioid and/or alcohol use disorder (s).

## 2. Methods

### 2.1. Study population and procedure

Details pertaining to the study's data collection methods have been reported previously (Tofighi, Lee, et al. 2019; Tofighi, Leonard, et al. 2019). Adult patients ( $\geq 18$  years), admitted to inpatient detoxification for alcohol and/or opioid use disorder(s) in a safety-net tertiary referral center in the New York City (NYC) area, were invited to participate in the study between February and August 2015. All patients included in the study were clinically diagnosed with SUD, with a primary diagnosis for AUD, OUD, or both. Most participants were admitted for alcohol (45%) detoxification, followed by heroin (34%) or concurrent alcohol and heroin (21%) detoxification. Trained research assistants administered a 49-item questionnaire via paper surveys, which took an average of 20–30 min to complete. The New York University Grossman School of Medicine Institutional Review Board and Bellevue Hospital Research Administration approved the study protocol.

Our study recruited all participants regardless of combustible cigarette or e-cigarette use history. A total of 206 patients agreed to participate and reimbursed with a \$10 transportation voucher upon completion of the survey. We approached 236 patients rendering a response rate of 87%. We excluded patients with missing data on key demographic, clinical and tobacco use variables ( $n = 2$ ) with final sample of  $N = 204$ . The present study focuses on current cigarette smokers among this sample ( $n = 158$ ), reflecting an overall smoking rate of 76% as we previously reported (Tofighi, Lee, et al. 2019).

### 2.2. Demographic and clinical variables

We included age, sex, race/ethnicity, housing status, education, employment, and past year incarceration in our survey. Questions pertaining to clinical characteristics (i.e., substance use, medical and psychiatric history) were based on self-report using survey items utilized in prior studies conducted by the study team in Bellevue Hospital's office-based buprenorphine program and inpatient detoxification program (Tofighi et al., 2016; Tofighi, Leonard, et al. 2019). Clinical variables included quantity and frequency of illicit drug and alcohol use, and psychiatric disease history.

### 2.3. Tobacco use variables

Survey items consisted of combustible cigarette quit attempts in the past 12 months and about beliefs and perception of e-cigarettes in

facilitating cessation from combustible cigarettes. These items were chosen based on prior qualitative and mixed-methods studies regarding smoking cessation strategies utilized by smokers, including the use of e-cigarettes (Choi & Forster, 2014; Pepper & Brewer, 2014; Choi, Fabian, Mottey, & Corbett, 2012). Specifically, combustible cigarette smoking status was defined as smoking cigarettes now, every day, or someday, in addition to daily smoking frequency in the past 30 days (1–19 vs. 20 or more). We also included cigarette dependence, measured using the Fagerstrom Test for Cigarette Dependence, defined as low/moderate ( $< 6$  points on FTCD) or high ( $\geq 6$  points on FTCD) dependence.

To assess current motivation to stop smoking, participants were asked: 'Which of the following describes you?' Response options were: (i) 'I don't want to stop smoking', (ii) 'I think I should stop smoking but don't really want to', (iii) 'I want to stop smoking but haven't thought about when', (iv) 'I REALLY want to stop smoking but I don't know when I will', (v) 'I want to stop smoking and hope to soon', (vi) 'I REALLY want to stop smoking and intend to in the next 3 months' and (vii) 'I REALLY want to stop smoking and intend to in the next month'. This ordering reflects: (i) absence of any belief, desire or intention, (ii) belief only, (iii) moderate desire but no intention, (iv) strong desire but no intention, (v) moderate desire and intention, (vi) strong desire and medium-term intention and (vii) strong desire and short-term intention (Kotz, Brown, & West, 2013).

E-cigarette use was coded as a binary variable for current use (daily or someday use) vs. no current use. We included four beliefs about e-cigarette use pertaining to their potential use for cessation: a) helping people quit; b) relative safety compared to cigarettes; c) being easier to find and obtain in comparison to nicotine patches and gum; and d) being cheaper compared to combustible cigarettes. We also included two items to assess e-cigarette related preferences: e) preferring to use e-cigarettes helping with quitting combustible cigarettes compared to nicotine patches and gum; and f) e-cigarette being 'cooler' compared to combustible cigarettes. All these items were based on a 5-point Likert scale ranging from disagree (1) to agree (5).

### 2.4. Substance use variables

We included Alcohol use as a binary variable using the sample mean for the cutoff point of 22.9 fl Oz/day where high use was  $\geq 22.9$  fl Oz/day. Illicit Drug use of heroin, crack/cocaine, and benzodiazepine misuse was coded as binary variable on whether participants use any of these substances or not. Additional information are available elsewhere (Tofighi, Lee, et al. 2019).

### 2.5. Statistical analysis

Descriptive statistics (sample size and proportions) were used to assess for demographic, clinical variables, tobacco use variables and other substance use characteristics. Variables were compared using chi-square statistics to contrast exclusive and dual (cigarette and e-cigarette) users. Based on findings, we further evaluated the association of prior quit attempts and e-cigarette use while adjusting for sociodemographic and clinical variables using multivariate logistic regression models. We also used independent sample *t*-test to compare mean beliefs and perceptions of e-cigarettes use among exclusive and dual smokers and represented the results via mean and standard deviations (SD). The significance level was set at  $p < 0.05$ .

## 3. Results

Among our sample of combustible cigarette smokers ( $N = 158$ ), the majority were males (92.4%) and more than half (53.2%) were between 31 and 49 years of age and reported completing a high school education or higher (69.6%). The majority (86.1%) were exclusive combustible cigarette smokers and the rest (13.9%) were dual users of cigarettes and e-cigarettes. Only one quarter of the sample (23.8%) reported stable

housing or had full- or part-time employment (25.7%). Table 1 presents the sample's demographic, clinical, substance use characteristics. There were no significant differences between exclusive and dual smokers regarding any of the domains measured in our study including substance use characteristic and intention to quit smoking categories as measured by the motivation to stop scale. However, there was significantly more dual smokers (81.8%) who reported having a quit attempt within the past 12 months compared to exclusive smokers (38.2%;  $p < 0.001$ ).

Respondents with dual combustible and e-cigarette use did not differ from exclusive cigarette users by demographic, clinical, or other substance use characteristics. Reported cigarette dependence and use frequency was not difference between exclusive and dual smokers. Compared to exclusive cigarette smokers, dual users were more likely to report a past year smoking quit attempt in the bivariate analysis (Table 1) and when adjusting for demographic variables Adjusted Odds Ratio = 8.56 (CI: 2.58, 28.35;  $p < 0.001$ ) (Table 2).

Overall, participants in our sample had overall mean favorable beliefs and preferences regarding e-cigarettes (Table 3). Dual smokers had significantly mean higher ratings that e-cigarettes can help people quit smoking regular cigarettes ( $M = 3.7, SD = \pm 1.4$ ) than exclusive combustible cigarette smokers [ $M = 2.7, SD = \pm 1.5, t(145) = -3.18, p = 0.002$ ]. Similarly, dual e-cigarette users elicited more favorable ratings regarding their preference to use e-cigarettes "to quit regular cigarettes

more than nicotine patches /gum" ( $M = 3.7, SD = \pm 1.7$ ) compared to exclusive cigarette smokers [ $(M = 2.6, SD = \pm 1.6, t(146) = -2.89, p = 0.005)$ ]. Finally, dual users believed that e-cigarettes are easier to find and obtain than nicotine patches or gum in order to quit smoking ( $M = 4.1, SD = \pm 1.3$ ) versus cigarette smokers only [ $(M = 3.1, SD = \pm 1.6, t(146) = -2.63, p = 0.009)$ ].

#### 4. Discussion

In this sample of adults undergoing inpatient treatment for SUD, cigarette smoking was three to five times higher than the general population in the US at the time of the survey (El-Shahawy, Park, Duncan, Lee, Tamura, Shearston, Weitzman, & Sherman, 2018). These findings were consistent with prior research with adults in other substance use treatment settings (Peters et al., 2015). Nevertheless, some smokers reported dual use of e-cigarettes. Dual users may have been using e-cigarettes to try to quit smoking, given they were more likely to have tried to quit smoking in the past year and shared the belief that e-cigarette use could help them quit combustible cigarette smoking. However, dual smokers did not differ in their current intention to quit smoking compared to exclusive cigarette smokers.

It has been hypothesized that e-cigarettes could be a more effective way to help people reduce the harm of combustible cigarette smoking or

**Table 1**  
Characteristics of exclusive cigarette smokers and dual E-cigarette users.

	Whole Sample N = 158	Exclusive Smokers n = 136	Dual Users n = 22	p-value
<b>Demographic and Clinical Characteristics</b>	N (%)	n (%)	n (%)	
Age				0.79 <sup>a</sup>
<30	30(19.0)	27 (19.9)	3 (13.6)	
31–49	84 (53.2)	72 (52.9)	12 (54.6)	
≥50	44 (27.8)	37 (27.2)	7 (31.8)	
Sex (Male)	146 (92.4)	126 (92.7)	20 (90.9)	0.67 <sup>a</sup>
Race/Ethnicity				0.82 <sup>b</sup>
White, non-Hispanic	57 (36.1)	50 (36.8)	7 (31.8)	
Black, non-Hispanic	59 (37.3)	51 (37.5)	8 (36.4)	
Hispanic & Other	42 (26.6)	35 (25.7)	7 (31.8)	
Type of Housing				0.42 <sup>a</sup>
Own or Rent	38 (24.0)	35 (25.7)	3 (13.6)	
Doubled up or Halfway housing	49 (31.0)	40 (29.4)	9 (40.9)	
Homeless/ Other	71 (44.9)	61 (44.9)	10 (45.5)	
Education (High School or more)	110 (69.6)	95 (69.9)	15 (68.2)	0.87 <sup>b</sup>
Employment				0.24 <sup>a</sup>
Full-time	25 (15.8)	24 (17.6)	1 (4.5)	
Part-time	15 (9.5)	13 (9.6)	2 (9.1)	
Unemployed	16 (10.13)	12 (8.8)	4 (18.2)	
Other	102 (64.60)	87 (64.0)	15 (68.2)	
Incarceration within the Past Year (Yes)	33 (20.9)	28 (20.6)	5 (22.7)	0.78 <sup>a</sup>
Has Psychological disorder <sup>c</sup> (Yes)	64 (40.5)	58 (42.7)	6 (27.3)	0.17 <sup>b</sup>
<b>Other Substance use Characteristics</b>				
Illicit Drug use <sup>d</sup> (Yes)	98 (62.4)	85 (62.5)	13 (61.9)	0.96 <sup>b</sup>
Past Month alcohol use <sup>e</sup> (High)	41 (40.2)	38 (41.8)	3 (27.3)	0.35 <sup>a</sup>
FTCD Score <sup>f</sup> (High dependence, ≥6)	39 (32.2)	31 (30.7)	8 (40.0)	0.42 <sup>b</sup>
Cigarettes per day 20 or more/day	65 (41.9)	58 (43.0)	7 (35.0)	0.50 <sup>b</sup>
Past year smoking quit attempt (Yes)	70 (44.3)	52 (38.2)	18 (81.8)	<0.001 <sup>a</sup>
<b>Motivation to Stop Scale<sup>g</sup></b>				0.62 <sup>a</sup>
1: 'I don't want to stop smoking'	8 (6.2)	6 (5.7)	2 (9.1)	
2: 'I think I should stop smoking but don't really want to'	23 (18.0)	19 (17.9)	4 (18.2)	
3: 'I want to stop smoking but haven't thought about when'	8 (6.2)	6 (5.7)	2 (9.1)	
4: 'I really want to stop smoking but I don't know when I will'	18 (14.1)	15 (14.1)	3 (13.6)	
5: 'I want to stop smoking and hope to soon'	31(24.2)	27 (25.5)	4 (18.2)	
6: 'I really want to stop smoking and intend to in the next 3 months'	8 (6.2)	5 (4.7)	3 (13.6)	
7: 'I really want to stop smoking and intend to in the next month'	32 (25.0)	28 (26.4)	4 (18.2)	

<sup>a</sup> P-value for Chi-square test

<sup>b</sup> P-value for Fisher exact test

<sup>c</sup> Includes diagnosis with one or more of the following: Depression, bipolar disorder, and Anxiety

<sup>d</sup> Illicit drugs include heroin, crack, crack/cocaine, and benzodiazepine misuse

<sup>e</sup> Past Month alcohol use was recoded into a binary variable using the sample mean for the cutoff point of 22.9 Fl Oz/day where high use was ≥ 22.9 Fl Oz/day

<sup>f</sup> FTCD (Fagerstrom Test for Cigarette Dependence) was recoded into low to moderate dependence (<6) and high dependence (≥6). We also calculated the difference in mean dependence among exclusive and dual smokers via a ttest and it was not statistically significant.

<sup>g</sup> We calculated the difference in mean motivation among exclusive and dual smokers via a ttest and it was not statistically significant.

**Table 2**  
Association of prior quit attempt with E-cigarette use.

Characteristics	Dual Users (Adjusted Odds Ratio)	95% Confidence Interval	p-value
<b>Past year smoking quit attempt</b>			
No	Ref		
Yes	8.56	(2.58, 28.35)	< 0.001
<b>Age</b>			
<30	Ref	Ref	Ref
30–49	1.58	(0.33, 7.54)	0.569
≥50	1.92	(0.32, 11.44)	0.474
<b>Sex</b>			
Male	Ref	Ref	Ref
Female	1.18	(0.15, 9.05)	0.875
<b>Race/Ethnicity</b>			
White, non-Hispanic	Ref	Ref	Ref
Black, non-Hispanic	1.42	(0.33, 6.05)	0.636
Hispanic & Other	1.66	(0.41, 6.72)	0.479
<b>Type of Housing</b>			
Own or Rent	Ref	Ref	Ref
Doubled up or Halfway housing	2.07	(0.42, 10.23)	0.371
Homeless/ Other	0.93	(0.19, 4.65)	0.929
<b>Education</b>			
Less than High school	Ref	Ref	Ref
High School of more	1.32	(0.34, 5.10)	0.687
<b>Employment</b>			
Full-time	Ref	Ref	Ref
Part-time	3.82	(0.20, 72.05)	0.372
Unemployed	13.11	(0.92, 186.89)	0.058
Other	5.14	(0.51, 51.71)	0.165
<b>Incarceration within the Past Year</b>			
Yes	Ref	Ref	Ref
No	0.70	(0.20, 2.49)	0.583
<b>Has Psychological disorder</b>			
No	Ref	Ref	Ref
Yes	0.50	(0.16, 1.57)	0.233

to quit smoking entirely by addressing both nicotine and behavioral dependence (Bullen et al., 2010). Some adults with SUD in our sample appear to be interested in quitting smoking, which may have prompted some to procure e-cigarettes. We previously reported using this sample that there was an overall lack of behavioral or clinician support to participants' cessation effort (Tofighi, Lee, et al. 2019). Thus, this reported initial desire to quit among dual smokers in our sample may not translate to effective steps for quitting combustible cigarettes using e-cigarettes. Instead, there seems to be a continued dual use pattern, which may limit the potential for overall harm reduction among smokers who can't not completely quit combustible cigarettes (Polosa, Rodu, Caponnetto, Maglia, & Raciti, 2013; Goniewicz et al., 2017).

Individuals with SUD have a higher prevalence of tobacco use and tend to have a higher degree of nicotine dependence compared to the general population (Baca & Yahne, 2009). To help alleviate their significant morbidity and mortality risk from smoking, a harm reduction approach may be more practical and pragmatic since e-cigarette use seems to be particularly appealing to patients with SUD (Peters et al., 2015). Further, for example, some studies have shown that, among the general population, e-cigarettes can make it more difficult for smokers to quit. Rather than quitting, they tend to revert to dual use with both products while having an intention to quit (Hajek et al., 2019). However, completely switching to e-cigarette can help potentially achieve harm reduction, compared to continuing dual use (Goniewicz et al., 2017). Smokers with SUD who are maybe interested in quitting seemed to remain dual users. This supports the findings that we noted in our study that although e-cigarettes may have the potential for being used in harm reduction approach if smokers completely switch to using them, interventions that help patients with SUD completely switch to e-cigarettes may help such a harm reduction approach rather than have them

**Table 3**  
Mean Beliefs Ratings Regarding E-cigarettes by cigarette and e-cigarette use status (N = 158).

E-cigarettes Beliefs (B) and Preferences (P)	Total Sample Mean (SD)	Cigarette smokers <sup>a</sup> n = 137 Mean (SD)	Dual users <sup>b</sup> n = 22 Mean (SD)	t-test value (df)	p-value
Help people quit smoking regular cigarettes (B)	2.8 (±1.5)	2.7 (±1.5)	3.7 (±1.4)	-3.18 (145)	0.002
Prefer to use e-cigarettes in comparison to nicotine patches/gum (P)	2.8 (±1.7)	2.6 (±1.6)	3.7 (±1.7)	-2.89 (146)	0.005
Easier to find and obtain than nicotine patches or gum in order to quit smoking (B)	3.3 (±1.6)	3.2 (±1.6)	4.1 (±1.3)	-2.63 (146)	0.009
Safer than smoking regular cigarettes (B)	3.1 (±1.5)	3.1 (±1.5)	3.6 (±1.6)	-1.50 (146)	0.135
Cheaper than smoking regular cigarettes (B)	3.1 (±1.5)	3.0 (±1.5)	3.5 (±1.6)	-1.36 (146)	0.175
'Cooler' than smoking regular cigarettes (P)	2.5 (±1.6)	2.5 (±1.6)	2.7 (±1.6)	-0.53 (146)	0.597

SD, Standard Deviation; df, Degrees of Freedom

<sup>a</sup> This group includes only exclusive cigarette smokers

<sup>b</sup> This group includes dual cigarette and e-cigarette users

stuck in the dual use phase. E-cigarette use appears to be growing and is well accepted in individuals who smoke and have a primary SUD (Peters et al., 2015), thus capitalizing on the potential of e-cigarette for harm reduction in such a hard to quit population may help reduce smoking morbidity (Ronckers et al., 2005; Stead et al. 2012; Goniewicz et al., 2017).

Our study also provides preliminary evidence that e-cigarette use may be driven by participants' apparent initial interest to switch from combustible cigarette smoking to a less harmful product, perhaps in an attempt to quit combustible cigarette smoking. Dual e-cigarette use was associated with having had a quit attempt in the past year. Whether these patients could eventually quit using e-cigarettes completely and remain nicotine free remains unclear. However, achieving maintenance of e-cigarette use to replace combustible cigarette smoking could be an important step in achieving a meaningful harm reduction approach among this patient population, or a way to attempt to quit combustible cigarettes. E-cigarettes contain substantially less toxicants and carcinogens than combustible cigarettes, thus posing a lower morbidity risk (Goniewicz et al., 2014). Dual smokers in our sample also reported preferring to use e-cigarettes in comparison to nicotine replacement therapy and that e-cigarettes were easier to find and obtain compared to nicotine replacement therapy. Given the cross-sectional nature of this study, we can't ascertain whether dual users were heavier combustible smokers prior to using e-cigarettes and thus may have achieved some potential harm reduction benefit. A related question is the extent to which any quitting assistance or harm reduction potential provided by e-cigarettes might be attributable simply to the behavioral replacement they provide. Thus, offering a mere replacement for combustible cigarette use when cigarette use is not allowed or mere enjoyment in experimenting with flavors (Caponnetto, Polosa, Russo, Leotta, & Campagna, 2011), as evident by their preference to use e-cigarettes compared to nicotine replacement therapy in our sample. The latter hypothesis cannot be examined in using our data given that we did not account for this information in our cross-sectional survey, a notable limitation of this study.

This study has several strengths. It accounted for variables that commonly occur with both tobacco and substance use (e.g., psychiatric symptoms), as well as common variables associated with combustible

cigarette smoking among adults in substance use treatment (e.g., frequency of cigarette smoking) (Guydish et al., 2011). However, this cross sectional survey cannot establish causality, items pertaining to tobacco use patterns, and self-reported drug and alcohol use may have been subject to recall bias, and false-reporting of certain behaviors (e.g., quit attempts) may have been influenced by social desirability bias (Delgado-Rodríguez & Llorca, 2004). We also can't eliminate residual confounding. Finally, this data was collected in 2015 and the e-cigarette market is rapidly evolving with new generation of e-cigarettes capable of delivering nicotine more effectively than combustible cigarettes such as JUUL (Huang et al., 2019), which perhaps can offer a better substitute for nicotine delivery than the e-cigarette that our participants used. We also we did not ask about reasons for using e-cigarettes in detail to account for the distinction between potential harm reduction and a goal of smoking cessation, nor asked about the types of devices and nicotine concentration that our participants used to maintain a feasible length for the survey.

Within this highly disadvantaged sample (i.e., unstable housing, unemployment), participants seemed interested in quitting combustible cigarette use by using e-cigarettes. Beliefs that e-cigarettes can facilitate smoking cessation, and being readily available in comparison to conventional cessation medications (that is not effective among this population), may offer a unique opportunity to suggest e-cigarette use among populations with SUDs interested in quitting combustible tobacco. Although we previously reported that few respondents were counseled by their providers regarding their cigarette and e-cigarette use (Tofighi, Lee, et al. 2019), findings from this survey highlight the importance of engaging patients enrolled in specialty addiction treatment settings to understand the future prospects for e-cigarettes, which is a less harmful product than combustible cigarettes, to reduce the burden of smoking. Further studies are needed to evaluate strategies that may improve adoption of smoking cessation strategies in specialty addiction treatment settings given the limited training and interest among clinicians and staff (El-Shahawy, Brown, and Elston Lafata 2016; Knudsen et al., 2010).

Patients expressed favorable beliefs regarding e-cigarettes being readily available in comparison to cessation medications and voiced perception that they prefer e-cigarettes in comparison to nicotine gum and patch. This highlights a great opportunity to evaluate the integration of e-cigarette in smoking cessation counseling. While most physicians do not formally recommend e-cigarettes as a cessation aid in the US, some of them do not refrain from letting patients use them if the patients are interested (El-Shahawy et al., 2016). Using e-cigarettes is not currently approved by the FDA as a medical device, instead e-cigarettes are currently regulated as tobacco products. Thus, a clear encouragement from physicians to switch to e-cigarette for smoking cessation or potential harm reduction needs further evaluation. Given the potential and interest that patient with SUD has in using e-cigarettes, further research needs to consider such beliefs and preferences among this hard to reach population in evaluating the potential for e-cigarette use in smoking cessation counseling for people in SUD treatment. E-cigarettes are currently widely available in convenience stores and gas stations, which could offer ease of access to a less harmful product (e-cigarette). However, the apparent harm reduction benefits of e-cigarette use with people in addiction treatment should be evaluated with caution. Combustible cigarette smoking is significantly associated with higher rates of SUD relapse after treatment (Weinberger et al., 2017). Whether e-cigarettes could have a similar impact on SUD treatment outcomes needs to be investigated. Given that there seems to be a high interest among patients in addiction treatment population is using e-cigarettes, further studies should explore the effectiveness of using e-cigarettes as an adjuvant in smoking cessation therapy or, perhaps, a harm reduction strategy for smokers with SUD and its interaction with SUD treatment relapse.

## CRediT authorship contribution statement

**Omar El-Shahawy:** Writing - original draft, Conceptualization, Methodology, Software, Formal analysis, Resources. **Daniel Schatz:** Writing - original draft, Investigation. **Scott Sherman:** Writing - review & editing, Supervision. **Donna Shelley:** Writing - review & editing, Supervision. **Joshua D Lee:** Supervision. **Babak Tofighi:** Methodology, Investigation, Writing - review & editing, Resources.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Contributors

Omar El Shahawy and Babak Tofighi designed the study, conceived the analysis and drafted and edited the manuscript. Omar El Shahawy performed the analysis. Scott Sherman, Daniel Schatz, Donna Shelley and Joshua Lee assisted with drafting the manuscript. All authors assisted with the analysis plan, interpretation of results and edited the final manuscript.

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