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E-cigarette knowledge, attitudes, and use in opioid dependent smokers

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Abstract

Individuals in treatment for opioid dependence have smoking rates 3-5 times greater than U.S. prevalence rate. Traditional smoking cessation strategies have been ineffective in this population. Novel approaches are needed as well as harm reduction avenues. E-cigarettes (ecigs) may provide such a novel harm reduction and cessation opportunity but little is known about the knowledge of, attitudes about, and usage of e-cigs in opioid dependent smokers. The current study enrolled 315 opioid dependent smokers (164 methadone, 151 buprenorphine), treated in the same health system in Fall River, Massachusetts. The sample was 49.7% male and 85.1% non-Latino White. Overall 98.7% had heard of e-cigs, 73.0% had ever tried e-cigs, and 33.8% had used e-cigs in the past 30 days. The most common reasons for use were curiosity (41.4%) and to quit all nicotine (26.0%). The proportion of opioid dependent smokers that had ever tried e-cigs and used them in the past month was substantially greater than that found in recent general population surveys. While e-cigs have been used to quit smoking, how to optimize their utility as a cessation tool remains undefined. E-cigs should be a part of smoking cessation discussions with this vulnerable, difficult-to-treat population.

Keywords

E-cigarettes; buprenorphine; methadone; smoking

1.0 Introduction

Cigarette smoking is the leading preventable cause of morbidity and mortality in the US and its health consequences remain particularly high in persons with drug use disorders (McCool & Paschall Richter, 2003). With smoking rates far exceeding the general population, opioid-

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dependent smokers experience high rates of tobacco-related health consequences (Centers for Disease Control and Prevention, 2007; Hser, McCarthy, & Anglin, 1994; Hurt, et al., 1996; Nahvi, Richter, Li, Modali, & Arnsten, 2006; Okoli, et al., 2010; Richter, Gibson, Ahluwalia, & Schmelzle, 2001). Of the estimated 2.5 million opioid abusers in the United States, over 300,000 persons are enrolled in outpatient opioid replacement therapy at any given time (Substance Abuse and Mental Health Services Administration, 2013). Smoking prevalence rates of 66-97% have been found among patients in the two types of opioid replacement therapy, methadone-maintenance treatment (MMT) (Best, et al., 1998; Clarke, Stein, McGarry, & Gogineni, 2001; Richter, Ahluwalia, Mosier, Nazir, & Ahluwalia, 2002; Richter, et al., 2001; Stark & Campbell, 1993) and office-based buprenorphine treatment (Harrell, Montoya, Preston, Juliano, & Gorelick, 2011; Lee, Grossman, DiRocco, & Gourevitch, 2009; Nahvi, Blackstock, Sohler, Thompson, & Cunningham, 2014; Pajusco, et al., 2012), in marked contrast to the US smoking prevalence of less than 20%. Hurt et al., (Hurt, et al., 1996) found that 51% of deaths in an opioid dependent cohort could be attributed to tobacco-related causes. Hser et al., (Hser, Hoffman, Grella, & Anglin, 2001) demonstrated that after controlling for a wide array of health-risk behaviors, tobacco use, even in a sample of long-term narcotic addicts, was one of the lifestyle markers most strongly correlated with subsequent mortality, with death rates four times higher than among non-smokers.

Over the past decade, researchers have evaluated smoking cessation treatment for opioid-dependent persons using behavioral and pharmacological treatment in conjunction with pharmacotherapy. All of the smoking cessation pharmacotherapies that have been tested in clinical trials with opioid dependent persons have produced far lower quit rates than those reported in non-drug users (Hurt, et al., 1994; Mooney, et al., 2008; Okoli, et al., 2010; Reid, et al., 2008; Shoptaw, et al., 2002; Stead, Perera, Bullen, Mant, & Lancaster, 2008; Stein, et al., 2006). Novel cessation treatment strategies are needed and tobacco harm reduction may be warranted as well.

“Electronic cigarettes” (e-cigs) contain liquid nicotine, a battery, and an atomizer, and look and feel like tobacco cigarettes. The liquid nicotine is heated, vaporized, and inhaled. These electronic nicotine delivery systems (ENDS) have gained worldwide attention, with awareness of electronic cigarettes, or e-cigarettes steadily growing in the United States every year (Adkison, et al., 2013; Choi & Forster, 2013; King, Alam, Promoff, Arrazola, & Dube, 2013; Regan, Promoff, Dube, & Arrazola, 2013). In recent surveys 11% to 31% of current smokers have ever used e-cigs (Adkison, et al., 2013; King, et al., 2013; Pearson, Richardson, Niaura, Vallone, & Abrams, 2012; Vickerman, Carpenter, Altman, Nash, & Zbikowski, 2013). A recent study enrolling hospitalized smokers found nearly all were aware of e-cigs and 46% reported e-cig use (Harrington, et al., 2014). By 2010, internet searches for e-cigarettes were more popular than for any other smoking cessation product, including nicotine replacement therapy and varenicline (Ayers, Ribisl, & Brownstein, 2011), despite federal regulations preventing e-cigarettes from being marketed or approved as a smoking cessation aid. Some analysts predict e-cig sales will surpass cigarettes sales within the decade (Ayers, et al., 2011; The Economist, March 23, 2013), with total sales approaching \$10 billion expected by 2017, up from \$2 billion in 2013 (Herzog & Gerberi, 2013).

In surveys and interviews, users often report that e-cigs help them quit smoking tobacco cigarettes, or help them stay quit (Adkison, et al., 2013; Carroll Chapman & Wu, 2014; Etter, 2010; Etter & Bullen, 2011; Goniewicz, Lingas, & Hajek, 2013; Kralikova, Novak, West, Kmetova, & Hajek, 2013), however there is limited evidence that e-cigs are efficacious as a smoking cessation aid (Bullen, et al., 2013). E-cig users also believe e-cigs are less toxic than cigarettes (Etter & Bullen, 2011; Goniewicz, et al., 2013; Pearson, et al., 2012), will reduce cigarette craving and nicotine withdrawal symptoms (Etter & Bullen, 2011; McQueen, Tower, & Sumner, 2011), are cheaper than cigarettes (Etter & Bullen, 2011; McQueen, et al., 2011), bother other people less, and can be used in places where smoking is forbidden (Etter & Bullen, 2011). Those who use e-cigs also report higher quitting self-efficacy, and more motivation to quit cigarette smoking (Pokhrel, Fagan, Little, Kawamoto, & Herzog, 2013). In a survey of US Midwestern adults, among those who were aware of e-cigs, over a quarter believed e-cigs were less addictive than regular cigarettes (Choi & Forster, 2013).

Given the modest health benefits of smoking reduction compared to cessation and the possibility that e-cigs may undermine cessation success, the overall health benefits of e-cigs (decreased toxicant exposure from less combustible nicotine use) remain uncertain. Little is known about the knowledge of, attitudes about, and usage of e-cigs in opioid dependent smokers. The purpose of the current study was to learn more about the usage patterns and perceptions of ecigs among heavily smoking, vulnerable populations enrolled in methadone or buprenorphine opioid agonist treatment so as to plan novel tobacco use cessation interventions.

2.0 Methods

We approached consecutive persons receiving treatment between January and July 2014 at a non-profit methadone maintenance program and a buprenorphine maintenance program that are part of the same health system and located one mile apart in Fall River, Massachusetts. At the methadone site, individuals were approached during regular dosing hours, and asked to complete the brief, ten-minute questionnaire anonymously. Interested individuals provided verbal informed consent and answered the survey items in a private interview location with a trained research assistant. They were compensated with a \$5 gift card to a local coffee shop for their time. Two percent of those approached refused participation.

Individuals receiving buprenorphine treatment were approached during a routine monthly visit by a trained research assistant or member of the program staff affiliated with the research study. Buprenorphine patients were asked to complete the identical, ten-minute questionnaire anonymously. Interested individuals provided verbal informed consent and answered the survey items in a private interview location with a trained research assistant. They were not compensated for the survey. Seven percent of those approached refused participation (demographic data from study refusers are not available). All procedures were approved by the Butler Hospital Institutional Review Board.

2.1 Measures

The ten-minute survey included questions related to demographics, opioid treatment method and dose, smoking history, including past quit attempts and medications used, and general health questions. We specifically asked if they had heard of e-cigs, had ever tried e-cigs, why they had used e-cigs, and whether they had friends or family who had tried e-cigs. We asked for level of agreement with six statements about e-cigs adapted from prior surveys (Adkison, et al., 2013; Choi & Forster, 2013), for example, “E-cigarettes are a lot less harmful than cigarettes”, or “E-Cigarettes have nicotine”; response categories on a five-point scale ranged from “Strongly agree” to “Strongly Disagree.”

2.2 Analytical Methods

We present descriptive statistics to summarize the characteristics of the sample. Participants recruited from buprenorphine and MMT clinics are separately described and statistically compared using t-tests for differences in means and the Pearson χ^2 -test of independence.

3.0 Results

Participants averaged 37.3 (\pm 10.7) years of age and 11.8 (\pm 2.1) years of education; 156 (49.7%) were male, 268 (85.1%) were non-Latino White, (Table 1). The mean number of cigarettes smoked / day was 15.2 (\pm 8.7). Nearly all (98.7%) participants reported they had heard of e-cigarettes, 227 (73.0%) reported they had ever tried e-cigs, and 105 (33.8%) had used e-cigs within the past month. Curiosity (41.4%) was the most frequently reported reason respondents said they last used an e-cig. Other reasons were to quit all nicotine (26%), to replace regular tobacco cigarettes (11.9%), to reduce use of regular cigarettes (10.6%), and because they could use e-cigs in environments where smoking was not allowed (6.2%). On average participants reported 16.5 (\pm 43.2) days of e-cigarette use during their last use episode. Just over 80% said they were willing to try e-cigs to help quit smoking.

Forty (12.7%) participants had ever called a smoking quit line (Table 1). Among those reporting a successful past year quit attempt (n = 163), 44 (26.8%) said they had been aided by nicotine replacement therapy, 12 (7.3%) said they had used other medications, 17 (10.4%) reported using e-cigarettes, 66 (40.5%) quit cold turkey, and 49 (29.9%) reported they had a 24-hour quit because they were in a non-smoking environment.

Participants' beliefs about e-cigarettes were assessed (Table 1). Just over two-thirds (68.2%) agreed or strongly agreed that e-cigs contain nicotine, 73.6% believed e-cigs could help people quit regular cigarette use, 79.1% said they could help reduce use of regular cigarettes, 65.6% believed they were less harmful than regular cigarettes, 71.6% said they could be used in non-smoking environments, and 41.8% believed they were less addictive than tobacco cigarettes.

Table 1 also presents data specific to persons in buprenorphine and methadone-maintenance treatment. Overall, the profiles of persons in these treatment modalities are quite similar. Compared to those in MMT, persons receiving buprenorphine were also significantly more likely (83.8% v. 63.2%) to have ever tried an e-cig, significantly less likely (44.7 v. 58.5%) to report a successful 24+ hour quit attempt in the past year, significantly more likely

(17.9% v. 5.2%) to report that a 24+ hour quit attempt was aided by e-cig use, and significantly less likely (34.5% v. 48.5%) to believe e-cigs are less addictive than regular cigarettes. They also tend to be less likely than those in MMT (19.4% v. 34.0%) to report they last used an e-cigarette to quit all nicotine. Participants recruited from buprenorphine and MMT clinics did not differ significantly with respect to any of the other characteristics evaluated in Table 1.

4.0 Discussion

The current study enrolled a sample of opioid-dependent individuals receiving either buprenorphine or methadone-maintenance treatment. Nearly everyone enrolled in this heavy-smoking population had heard of e-cigs and almost three-quarters had tried e-cigs. This is a substantially higher percentage than what has been reported in general population surveys (Adkison, et al., 2013; King, et al., 2013; Pearson, et al., 2012), or in a sample of hospitalized smokers (Harrington, et al., 2014), another heavy-smoking population. While our study was done more recently and may in part reflect the nationwide expansion in e-cig use, it is likely the high rates we report are due in part to the closed social environment of these substance abuse treatment clinics. Patients at both treatment sites visit the clinic frequently (in the case of MMT often daily), and may develop close social bonds with other smokers who have tried e-cigs. Nearly 40% reported borrowing e-cigs from friends or family, and over 40% tried e-cigs out of curiosity, which is not consistent with current smokers' reported motivations for trying e-cigs in the literature (Carroll Chapman & Wu, 2014; Goniewicz, et al., 2013). We enrolled a largely non-Latino White population reflecting the demographics of the opioid agonist treatment community in this region. E-cig use has been reported to be higher among non-Latino Whites than among racial and ethnic minority populations (Adkison, et al., 2013; Harrington, et al., 2014; King, et al., 2013; Pearson, et al., 2012; Vickerman, et al., 2013). These findings, combined with the high rates of use, may indicate e-cig sharing, or word of mouth advertising among largely ethnically homogenous social networks at the two treatment sites.

Consistent with previous work (Adkison, et al., 2013; Choi & Forster, 2013; Goniewicz, et al., 2013; Pearson, et al., 2012), a majority of participants in the current study believe e-cigs are less harmful than tobacco cigarettes. Additionally, just over 40% believe e-cigs are less addictive than tobacco cigs, which is a lower proportion than found in an internet survey of e-cig users (Goniewicz, et al., 2013). Given the large percentage of participants in the current study who also agreed that e-cigs can be used to reduce or quit tobacco cigarette usage, more research is needed into the safety and efficacy of e-cigs as smoking cessation aids. Although they are not approved as cessation products, individual users believe they are efficacious as cessation aids, and believe they will assist in a quit attempt; unfortunately e-cigs are being marketed as cessation aids (Grana & Ling, 2014). A recent review of e-cig prevalence and use noted that many e-cig users are motivated to quit or substitute their tobacco cigarettes (Carroll Chapman & Wu, 2014).

Although the buprenorphine and MMT samples are very similar, buprenorphine participants were significantly more likely to have ever tried e-cigs. Participants enrolled from the buprenorphine clinic were also significantly younger than those in MMT. Younger age has

been related to increased awareness and use of e-cigs in previous general population surveys (Adkison, et al., 2013; Pearson, et al., 2012). Previous work has also found that those enrolled in buprenorphine are more likely to have higher socioeconomic status (SES) indicators than those in MMT (Fingerhood, King, Brooner, & Rastegar, 2014), although we did not measure SES here. Higher SES, like younger age, has been associated with a greater likelihood of e-cig use in the extant literature (Adkison, et al., 2013; Harrington, et al., 2014). It is possible SES differences between the groups could help explain the higher lifetime e-cig use. Future work should collect more detailed SES data.

This study has important strengths. To our knowledge, this is the first work to assess ecig usage and perceptions in opioid dependent individuals; a heavy smoking, vulnerable population. Second, this study includes a wide range of questions about e-cig awareness, use, reasons for use, and beliefs about e-cigs, allowing for a thorough evaluation of the use and perceptions of e-cigs in this population. Finally, we enrolled individuals receiving both buprenorphine and MMT, allowing for comparisons between the groups.

This study also has limitations which should be considered. First, this sample is 85% non-Latino White, consistent with the population of the county where the data were collected, but limiting generalizability to more racially diverse opioid treatment facilities. Second, the number of participants endorsing some answers, for example, a successful 24 hour quit attempt aided by e-cigarettes, was low. Therefore, despite statistically significant differences between those receiving buprenorphine and MMT, results should be interpreted with that in mind. Third, reasons for e-cig use are limited to the last time individuals used their e-cig. Future work should probe the sometimes complex reasons for using e-cigs. Fourth, we do not know what type of ecigs participants used or for how long, if conventional cigarettes were used concurrently, nor if treatment duration impacted quit attempts or success. Finally, these data are cross-sectional and descriptive. More in-depth, longitudinal analyses of e-cig use in this population would be of great benefit.

4.1 Conclusions

E-cigs are a rapidly emerging tobacco alternative. In a best-case scenario they provide a safe, efficacious, alternative smoking cessation treatment. However, more research is needed to determine their potential and safety in that regard. The current study evaluated current usage patterns and perceptions of e-cigs in opioid dependent individuals receiving either buprenorphine or MMT. Opioid individuals smoke at rates far exceeding those seen in the general population and are resistant to current smoking cessation methods, making innovative, safe, smoking cessation treatment modalities of potential great public health benefit in this population. From the current study, this population has also used e-cigs at much higher rates than the general population, but perhaps not in structured ways that might optimize their utility as a cessation tool. A discussion of the possible risks and unknown benefits of e-cigs should be incorporated into discussions of smoking or smoking cessation conducted at opioid treatment sites.

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Highlights

- We assessed e-cigarette usage and perceptions in opioid dependent individuals.
- We compared e-cigs in methadone-maintained vs. buprenorphine-maintained persons.
- 98.7% had heard of e-cigarettes, and 73.0% reported they had ever tried e-cigs.
- Curiosity (41.4%) was the most frequently reported reason for last use.
- Nearly two-thirds of respondents believed e-cigs were less harmful than cigarettes.

Table 1

Background Characteristics, Smoking Behaviors, and E-Cigarette Use, Perceptions, and Beliefs by Treatment Modality.

	Full Sample (n=315)	Buprenorphine (n = 151)	Methadone (n = 164)	t (p =) or χ^2 (p =)
Age	37.3 (\pm 10.7)	35.8 (\pm 10.7)	38.65 (\pm 10.5)	-2.39 (.02)
Education	11.8 (\pm 2.11)	11.8 (\pm 2.19)	11.9 (\pm 2.04)	-0.40 (.69)
Gender (Male)	156 (49.7%)	80 (53.3%)	76 (46.3%)	1.53 (.22)
Ethnicity				
White	268 (85.1%)	128 (84.8%)	140 (85.4%)	
African-American	6 (1.9%)	2 (1.3%)	4 (2.4%)	1.29 (.73)
Latino	20 (6.4%)	9 (6.0%)	11 (6.7%)	
Other	21 (6.7%)	12 (8.0%)	9 (5.5%)	
Mean Cigs / day	15.2 (\pm 8.74)	14.4 (\pm 8.84)	15.9 (\pm 8.61)	-1.52 (.13)
Buprenorphine/Methadone Dose (mg)	NA ^a	15.9 (\pm 5.0)	83.2 (\pm 36.2)	
Heard of E-Cig(Yes)	311 (98.7%)	148 (98.0%)	163 (99.4%)	1.19 (.28)
Ever Tried an E-Cig (Yes)	227 (73.0%)	124 (83.8%)	103 (63.2%)	16.69 (.00)
Recent (Past Month) E-Cig User (Yes)	105 (33.8%)	54 (36.5%)	51 (31.3%)	0.94 (.33)
Reasons for last E-Cig Use ^b				
To Quit All Nicotine	59 (26.0%)	24.0 (19.4%)	35 (34.0%)	
Switched to Replace	27 (11.9%)	18 (14.5%)	9 (8.7%)	
Used to Cut Down	24 (10.6%)	14 (11.3%)	10 (9.7%)	12.41 (.05)
Tobacco not allowed	14 (6.2%)	11 (8.8%)	3 (2.9%)	
In Addition to Cigs	7 (3.1%)	6 (4.8%)	1 (1.0%)	
Curiosity	94 (41.4%)	50 (40.3%)	44 (42.7%)	
Other	2 (0.9%)	1 (0.8%)	1 (1.0%)	
E-Cig Source ^b				
Purchased	126 (55.5%)	67 (54.0%)	59 (57.3%)	0.89 (.24)
Borrowed	87 (38.3%)	49 (39.5%)	38 (36.9%)	
Other	14 (6.2%)	8 (6.5%)	6 (5.8%)	
Days Used E-Cigs ^b	16.5 (\pm 43.2)	17.3 (\pm 51.5)	15.7 (\pm 30.4)	0.28 (.78)
Ever Called Smokig Quit Line (Yes)	40 (12.7%)	20 (13.3%)	20 (12.2%)	0.08 (.78)
Past Year NRT Use (Yes)	104 (33.0%)	53 (35.1%)	51 (31.1%)	0.57 (.45)
Past Year Chantix Use (Yes)	30 (9.5%)	14 (9.3%)	16 (9.8%)	0.02 (.88)
Past Year Bupropion Use (Yes)	11 (3.5%)	3 (2.0%)	8 (4.9%)	1.95 (.16)
Any successful 24 Hour+ Quit Attempts (Past Year)	163 (51.9%)	67 (44.7%)	96 (58.5%)	6.04 (.01)
Aided by NRT ^c	44 (26.8%)	20 (29.9%)	24 (25.0%)	0.47 (.49)
Aided by E-Cigarettes ^c	17 (10.4%)	12 (17.9%)	5 (5.2%)	6.82 (.01)
Aided by Other Medications ^c	12 (7.4%)	5 (7.5%)	7 (7.3%)	0.00 (.97)
Unaided (Cold Turkey) ^c	66 (40.5%)	30 (44.8%)	36 (37.5%)	0.87 (.35)

	Full Sample (n=315)	Buprenorphine (n = 151)	Methadone (n = 164)	t (p =) or χ^2 (p =)
In Non-Smoking Environment	49 (30.1%)	15 (22.4%)	34 (35.4%)	3.19 (.07)
Willing to Try e-cigs to help quit smoking (Yes)	249 (80.1%)	116 (78.4%)	133 (81.6%)	0.50 (.48)
<i>Beliefs About E-Cigarettes^d</i>				
E-cigs Contain Nicotine	213 (68.2%)	105 (71.0%)	108 (66.3%)	0.79 (.37)
E-cigs Can Help Quit Regular Cigarette Use	229 (73.6%)	103 (69.6%)	126 (77.3%)	2.37 (.12)
E-cigs are Less Harmful than Regular Cigarettes	204 (65.6%)	93 (62.8%)	111 (68.1%)	0.95 (.33)
E-Cigs Can Help Reduce Regular Cigarette Use	246 (79.1%)	111 (75.0%)	135 (82.8%)	2.87 (.09)
E-Cigs Can be Used in Non-Smoking Environments	222 (71.6%)	102 (69.4%)	120 (73.6%)	0.68 (.41)
E-Cigs are Less Addictive Than Regular Cigarettes	130 (41.8%)	51 (34.5%)	79 (48.5%)	6.26 (.01)

^a Appropriate dosages are specific to treatment modality.

^b Includes only persons (124 in Buprenorphine and 103 in Methadone) who reported ever trying an e-cigarette.

^c Includes only persons (67 in Buprenorphine and 96 in Methadone) with 1 or more successful 24-hour quits in the past year. Note that persons may have more than 1 24-hour quit in the past year and quit aids (e.g., NRT and e-cigarettes) are not mutually exclusive.

^d Includes only persons (148 in Buprenorphine and 163 in Methadone) who reported they had heard of e-cigarettes. Items were originally coded on a 5-point strongly disagree to strongly agree response framework. The reported n and % give the number and % who "agreed" or "strongly agreed" with the statement.