



Published in final edited form as:

*J Dual Diagn.* 2016 ; 12(2): 109–117. doi:10.1080/15504263.2016.1172895.

## E-cigarette Use in Veterans Seeking Mental Health and/or Substance Use Services

Kathryn Hefner, Ph.D.<sup>1,2</sup>, Robert Rosenheck, M.D.<sup>1,2</sup>, Jeremy Merrel, B.A.<sup>1</sup>, Mercedes Coffman, M.A.<sup>1,2</sup>, Gerry Valentine, M.D.<sup>1,2</sup>, and Mehmet Sofuoglu, M.D., Ph.D.<sup>1,2</sup>

Kathryn Hefner: kathryn.hefner@yale.edu; Robert Rosenheck: robert.rosenheck@yale.edu; Jeremy Merrel: jeremy.merrel@va.gov; Mercedes Coffman: mercedes.coffman@yale.edu; Gerry Valentine: gerald.valentine@yale.edu; Mehmet Sofuoglu: mehmet.sofuoglu@yale.edu

<sup>1</sup>Veterans Health Administration Mental Illness Research, Education and Clinical Center (MIRECC), West Haven, CT

<sup>2</sup>Yale University School of Medicine, Department of Psychiatry, New Haven, CT

### Abstract

**Objective**—Individuals with mental illness and substance use disorders smoke at elevated rates and tend to have greater difficulty quitting smoking as compared to the general population. Some believe that e-cigarettes may reduce harm associated with smoking, but little is known about e-cigarette use, perceptions, and motivations for their use among individuals with mental health and/or substance use disorders.

**Methods**—Rates and correlates of e-cigarette use, perceptions, and sources of information about e-cigarettes among smokers seeking mental health and/or substance use services ( $N=188$ ) at the VA Connecticut Healthcare System were assessed via a brief survey. The Pearson  $\chi^2$  test of independence was used to compare veterans who currently used e-cigarettes with those who did not. Logistic regression was used to examine independent attitudinal differences controlling for potentially confounding variables.

**Results**—Participants were generally male (90%), Caucasian (54%), and over the age of 50 (69%), with high rates of at least one mental health condition (82%), at least one substance use disorder (73%), and comorbid mental health and substance use disorders (55%). A relatively high proportion of the sample (30.9%) used e-cigarettes. These participants, compared to those who did not use e-cigarettes, were more likely to have a mental health disorder and less likely to have a substance use disorder, started smoking later in life, spent less money on smoking, and were more likely to have tried to quit “cold turkey.” Knowledge of e-cigarettes originated most often from TV, radio or personal contacts. Respondents held generally positive perceptions and motivations regarding e-cigarette use (i.e., it is socially acceptable, may help reduce/quit smoking, less harmful to others). Despite positive attributions, rates of dual use of e-cigarettes and traditional cigarettes was high (86.2%), and very few people using e-cigarettes (6.9%) indicated that e-cigarettes actually helped them quit smoking, suggesting little related harm reduction.

---

Corresponding author: Kathryn Hefner, PhD, 950 Campbell Avenue, West Haven, CT 06516.

### DISCLOSURES

All authors declare no financial relationships with commercial interest or potential conflicts of interest.

**Conclusions**—E-cigarettes are commonly used by smokers with mental health conditions and/or substance use disorders, a high-risk group that feels positively about e-cigarettes. However, positive regard of e-cigarettes did not appear to translate to ability to reduce or quit cigarette smoking. Safety and effectiveness research on e-cigarettes is urgently needed.

### Keywords

e-cigarettes; smoking; mental health; veterans; substance use disorders; dual diagnosis; mental illness

---

Cigarette smoking is the main cause of preventable death in developed countries (US Department of Health and Human Services, 2014; Centers for Disease Control, 2008), with a current prevalence of 19.8% in the U.S. adult population (Jamal et al., 2014). Although recent efforts to reduce smoking have been successful among the general U.S. population, these interventions have not worked as effectively for individuals with mental health or substance use disorders – a population that smokes at increased rates as compared to the general population (Lasser et al., 2000; Cook et al., 2014; Hartz et al., 2014; Mackowick et al., 2012; Vanable et al., 2003). Thus, there is a great need to better understand and treat tobacco use disorder among individuals with mental illness and/or substance use disorder (Mackowick et al., 2012).

Recently, e-cigarettes have been proposed as an approach to reduce harm and help individuals to quit smoking (Hajek, 2014; Elam, 2015; Etter & Eissenberg, 2015; Benowitz, 2014; Bullen et al., 2013), a belief that is apparently shared by many people who use e-cigarettes (Hummel et al., 2015; Dawkins et al., 2013; Li et al., 2013). This notion is supported by preliminary evidence that e-cigarettes may help smokers reduce or quit smoking (McRobbie et al., 2014; Caponnetto et al., 2013a), and that e-cigarettes are less addictive than tobacco cigarettes (Etter & Eissenberg, 2015). However, substantial debate remains regarding the relative merits of such claims, and further research is needed (McRobbie et al., 2014). For example, the rapid increase of e-cigarette use among youth has raised concerns about the risk that e-cigarettes operate as a “gateway” to using traditional tobacco products increasing potential harm -- a concern that has been substantiated to some extent (Dutra & Glantz, 2014; Kandel & Kandel, 2014; Leventhal et al., 2015). Available evidence suggests that dual use of smokeless tobacco and traditional cigarettes is unlikely to lead to harm reduction (Meija, Ling & Glantz, 2010). One study suggested that individuals endorsing psychiatric symptoms are particularly likely to have tried and to continue using e-cigarettes (Cummins et al., 2014). In a clinical trial of smokers with severe mental illness, e-cigarette use increased over time, especially among those interested in quitting, but was unrelated to changes in smoking behavior (Prochaska & Grana, 2014), suggesting that dual use of e-cigarette and traditional cigarettes may be a particular risk among those with severe mental illness. However, these authors did not directly ask about e-cigarette use in that study, relying instead on participants’ self-disclosure of e-cigarette use. Given this limitation, their findings likely underestimate the true prevalence of e-cigarette use in this population (Prochaska & Grana, 2014), warranting further study. Given that risks associated with e-cigarettes are largely unknown, and that findings are too limited to evaluate the efficacy of e-cigarettes for smoking cessation and harm reduction (Franck et al., 2014), it

remains important to characterize smokers' perceptions of e-cigarettes, motivations to use e-cigarettes, and sources of information about e-cigarettes among people with mental health and/or substance use disorders. To date, prevalence and patterns of e-cigarette use among veterans, particularly those with mental health and substance use disorders, have been largely unexamined.

The present study was developed to fill these gaps in the literature. A convenience sample of current smokers (i.e., veterans who reported smoking within the past month) presenting for appointments in mental health and substance use clinics at the VA Connecticut Healthcare System was recruited to complete the survey. We sought to: 1) identify rates of e-cigarette use among veterans who smoke and have been diagnosed with mental health and/or substance use disorders receiving services at a large Veterans Health Administration facility, and 2) examine differences between smokers of traditional cigarettes and e-cigarettes in this population in patterns of tobacco use, motivations for using e-cigarettes, perceptions of e-cigarettes, and sources of information about e-cigarette use.

## **METHODS**

### **Participants and procedures**

Recruitment occurred between March and May 2015 at mental health and substance abuse clinics at the VA Connecticut Healthcare System (West Haven VA and Newington VA campuses). We approached veterans presenting for treatment and asked if they were current or recently former (quit within past 30 days) smokers. If they were, we explained the study and discussed their participation. Interested participants provided verbal consent and completed the brief questionnaire anonymously using pen and paper. Because only de-identified data were collected, this study was granted exemption from Institutional Review Board review. It was approved by the Research and Development Committee of the VA Connecticut Healthcare System, and conducted in accordance with the Declaration of Helsinki. Participants were compensated for their time with a \$5 gift card redeemable at VA cafeterias, shops and/or coffee shops.

### **Survey**

The 38-item survey took approximately 10-minutes to complete. It included questions related to demographics (self-reported race/ethnicity, gender, etc.), traditional cigarette smoking history, current smoking behavior, and history of quit attempts as well as methods used (some items and content adapted from surveys developed and used by Krishnan-Sarin and colleagues: Camenga et al., 2015; Kong et al., 2015). The survey included items about previously diagnosed mental health and substance use disorders, past treatment, and general health. In addition, it assessed knowledge and usage of e-cigarettes, sources of information about e-cigarettes, and perceptions about, and motivations for, using or possibly using e-cigarettes (e.g., "E-cigarettes save money"; "E-cigarettes reduce the amount I smoke"). Although all participants may not have personally used e-cigarettes, we were also interested in perceptions of e-cigarettes among smokers who had not yet tried e-cigarettes – as these individuals are likely to have opinions about e-cigarettes that will influence whether they try e-cigarettes in the future.

## Analyses

We first present descriptive statistics summarizing the characteristics of the sample. Participants were then classified based on current e-cigarette use (i.e., use in the last 30 days vs. no use) and were statistically compared using the Pearson  $\chi^2$  test of independence. Logistic regression was utilized to assess independence of attitudinal differences between veterans who were using e-cigarettes and those who were not, controlling for potentially confounding demographic and/or clinical variables.

## RESULTS

Of the 206 participants meeting eligibility criteria and completing the survey during the study period, most ( $N=188$ ) reported at least one non-substance related mental health and/or a substance use disorder, and were included in subsequent analyses. Respondents were generally representative of veterans who use VA services (Rosenheck et al., 2004). Demographic and clinical information is reported in Table 1 by current e-cigarette use status. Participants were predominantly male ( $n=174$ , 90%) and Caucasian ( $n=101$ , 54%), mostly over the age of 50 ( $n=129$ , 69%), and had the equivalent of a high school education ( $n=84$ , 45%) or some college ( $n=77$ , 41%). Just under a third ( $n=58$ , 31%) were currently using e-cigarettes. There were no significant group differences on any demographic characteristic.

### Mental health condition and substance use disorders

Overall, 82% of participants ( $n=155$ ) reported at least one mental health condition, 73% ( $n=137$ ) reported a substance use disorder, and 55% ( $n=104$ ) reported both mental health condition(s) and substance use disorder(s). The most common mental health conditions reported were posttraumatic stress disorder (PTSD;  $n=83$ , 44%), depression ( $n=75$ , 40%), and anxiety disorder ( $n=67$ , 36%), while approximately half reported alcohol use disorder ( $n=92$ , 49%) and other substance disorder ( $n=99$ , 53%).

Veterans currently using e-cigarettes were significantly more likely to report having a (non-substance related) mental health disorder (e.g., PTSD, bipolar disorder, depression, anxiety disorder, and/or schizophrenia) and less likely to have a substance use disorder than those not currently using e-cigarettes (Table 1). Specifically, those using e-cigarettes, compared to those who were not, were less likely to have alcohol use disorders. However, there was substantial overlap between substance use disorder and mental health diagnoses.

Among veterans using e-cigarettes, 39.7% had a mental health diagnosis alone, yet only 21.5% of those not using e-cigarettes had a mental health diagnosis alone. In fact, among all individuals with a mental health only diagnosis, 45.1% (23 out of 51) used e-cigarettes. In contrast, individuals using e-cigarettes reported low rates of substance use disorder diagnosis alone (6.9%), while 22.3% of those not using e-cigarettes had substance use disorders only. There was no significant relationship between e-cigarette use and dual diagnosis.

We further categorized participants with mental health diagnoses into those with milder conditions (depression, anxiety disorder, PTSD, or substance use disorders) and more severe mental illness (bipolar disorder, schizophrenia). The prevalence of severe mental illness did not differ between veterans using e-cigarettes and those who were not. However, as

compared to those with milder mental health conditions and/or substance use disorders, individuals with severe mental illness were more likely to report daily cigarette smoking,  $\chi^2=7.28$ ,  $df=2$ ,  $p=.026$ , and were less likely to have attempted to quit smoking via counseling,  $\chi^2=15.08$ ,  $df=1$ ,  $p<.001$ , and less likely to have successfully quit using nicotine replacement treatments,  $\chi^2=11.13$ ,  $df=1$ ,  $p<.001$ .

### Smoking behavior

Compared to those not using e-cigarettes, veterans currently using e-cigarettes reported starting smoking later in life, spending less money on smoking, and having made a “cold turkey” attempt to quit smoking in the past (Table 2). There were no other differences in smoking behaviors between veterans who were versus were not currently using e-cigarettes. About half of survey respondents reported having attempted to quit smoking one to four times in the past (52.1%), and about half (52.7%) had made a quit attempt in the past year. In addition, 36.2% of all respondents reported previously trying to quit using e-cigarettes, but only 4.8% reported successfully quitting smoking at some point with the help of e-cigarettes.

### E-cigarette use and perceptions

Veterans currently using e-cigarettes comprised nearly a third of all participants (30.9%). The majority of this group also reported using tobacco cigarettes (86.2%), with only 12.1% reporting exclusive e-cigarette use in the past 30 days (1 participant did not respond). Among those using e-cigarettes, 39 (67.2%) reported using e-cigarettes 1–10 days out of the past month, followed by 16 (27.6%) who reported using e-cigarettes 21–30 days in past month, and only 3 (5.2%) who used e-cigarettes 11–20 days in past month. Of those who had not used e-cigarettes in the past, 36.0% ( $n=47$ ) indicated they might try e-cigarettes in the next three months.

Among those using e-cigarettes, the most frequent reasons for using e-cigarettes were the ability to use e-cigarettes in non-smoking areas (64.8%), saving money (53.7%), and the perception that vapor is less harmful to others (40.7%). Those using e-cigarettes, as compared to those not using, were significantly more likely to endorse using e-cigarettes because they could be used in non-smoking areas, because they perceived them to be less harmful to others, to reduce other tobacco product use, because friends and family prefer e-cigarettes, and because e-cigarettes taste better and have a greater flavor variety. Veterans using e-cigarettes were less likely to endorse feeling that e-cigarettes should be regulated like cigarettes and other tobacco products compared to those not using e-cigarettes (see Table 3).

Only 12.1% ( $n=7$ ) of veterans using e-cigarettes indicated that flavor variety was “very important” or that it was the primary reason they used e-cigarettes. These individuals primarily reported having used only one flavor of liquid in the past 30 days ( $n=30$ , 51.7%). Among those using e-cigarettes, the most commonly reported nicotine concentration was 6–12 mg/ml (0.6–1.2%) ( $n=11$ , 19.0%), followed by 18–24 mg/ml (1.8–2.4%) ( $n=10$ , 17.2%); although an additional 17.2% ( $n=10$ ) of veterans using e-cigarettes indicated they were not sure of the nicotine concentration they used. The most common types of e-cigarettes

respondents indicated having used were disposable ( $n=18$ , 31.0%), rechargeable ( $n=16$ , 27.6%) or refillable ( $n=12$ , 20.7%).

### Logistic Regression Analyses

Given observed differences in some clinical variables (mental health and, substance use disorders, and age of smoking initiation) between those using and not using e-cigarettes we considered the independent effects of these factors in a logistic regression model, with current e-cigarette use as the dependent variable. In this model, both later age of initiation;  $OR = 3.17$ , 95% CI [1.38, 7.28],  $p=.007$ ; and any mental health diagnosis;  $OR = 3.24$ , 95% CI [1.02, 10.25],  $p=.046$ ; significantly predicted odds of current e-cigarette use.

We then examined whether attitudinal differences observed between those currently using and not using e-cigarettes, remained significant after controlling for age of smoking initiation and mental health diagnosis. Of the observed attitudinal differences, motivation to use e-cigarettes because they could be used in non-smoking areas remained significantly associated with e-cigarette use, net of other effects,  $OR = 0.15$ , 95% CI [0.07, 0.32],  $p<.001$ , as did reducing harm to others,  $OR = 0.37$ , 95% CI [0.18, 0.74],  $p=.005$ , reducing other tobacco use,  $OR = 0.38$ , 95% CI [0.18, 0.81],  $p=.012$ , preferences of friends or family members,  $OR = 0.21$ , 95% CI [0.07, 0.70],  $p=.011$ , better taste/flavor variety,  $OR = 0.13$ , 95% CI [0.03, 0.46],  $p=.002$ , and the belief that e-cigarette should be regulated like other tobacco products,  $OR = 2.53$ , 95% CI [1.24, 5.17],  $p=.011$ , (with those using e-cigarettes less likely to endorse this belief).

## DISCUSSION

The present study examined rates of current e-cigarette use, general smoking behavior, perceptions, motivations and sources of information about using e-cigarettes, among veterans with mental health and/or substance use disorders receiving services through the VA Connecticut Healthcare System. Key findings of this survey were: 1) current e-cigarette use in this population, at 30.9%, was somewhat higher than what has been observed in the general population; 2) compared to veterans not using e-cigarettes those using e-cigarettes were more likely to have mental health disorders and less likely to have substance use disorders (especially alcohol use disorder), and had started smoking later in life (after age 20); 3) individuals learned about e-cigarettes primarily through TV, radio, friends, family, and coworkers with few differences between those using and not using e-cigarettes; 4) participants generally had positive perceptions of e-cigarettes and were motivated to use them because they are more socially acceptable, may reduce harm to others and are preferred by others; 5) rates of dual use of e-cigarettes and traditional cigarettes were high, and 6) use of e-cigarettes did not seem to help participants reduce or quit smoking. Below, we discuss the implications of these findings.

Current (i.e., past month) e-cigarette use was somewhat higher among our sample (30.9%) than it was in a recent general population sample of smokers (21%; Emery, 2013), indicating that awareness and use of e-cigarettes has successfully expanded to veterans with mental health and/or substance use disorders. This was somewhat surprising given that e-cigarette advertisements generally target young adults; though in some cases e-cigarettes have been

specifically marketed as a means to manage psychiatric symptoms (Cummins et al., 2014; Smokeless Delite, 2012; Quit in Time, 2011). Past month e-cigarette use was also somewhat higher among our sample compared to a sample of individuals in outpatient substance abuse treatment (23%; Peters et al., 2015), though it should be noted that only 69% of that sample was comprised of current smokers (vs. 100% in the present study). In contrast to the general population of individuals using e-cigarettes, far fewer in our sample indicated they had learned of e-cigarettes through the internet (14.8% in our sample vs. 41% in the general population), and relatively many more indicated they had learned of e-cigarettes through TV or radio (31.5% vs. 10%) (Dawkins et al., 2013).

The relatively prevalent use of e-cigarettes in the current study was matched with generally positive perceptions of e-cigarettes, including the expectation that e-cigarettes are cheaper and less harmful to others than tobacco cigarettes, and would help them reduce smoking (Hummel et al., 2015; Dawkins et al., 2013; Li et al., 2013; Franck et al., 2014). Indeed, veterans currently using e-cigarettes in our sample did report spending less money on smoking than those not using e-cigarettes. In addition, recent studies indicate that those who consider harm of smoking for others are likely to continue using e-cigarettes (Hummel et al., 2015). In contrast, substantially fewer individuals using e-cigarettes in our sample indicated they might use e-cigarettes because they are healthier as compared to past research conducted with healthy controls (25.9% vs. 81%) (Dawkins et al., 2013). Given stigma surrounding mental health disorders, particularly within military populations (Green-Shortridge et al., 2007), our participants may be especially concerned with social desirability and inclusiveness, relating to their motivations involving relationships with others and a desire not to be relegated to dwindling smoking areas. Although a greater percentage of veterans not using e-cigarettes than those using e-cigarettes agreed that e-cigarettes should be regulated, (61.2% vs. 40.7%), more than a third (36%) of veteran smokers who had never tried e-cigarettes reported they might try e-cigarettes in the next three months, supporting an overall generally positive attitude to e-cigarette among veterans not currently using e-cigarettes as well.

Similar to what has been observed in previous e-cigarette research among individuals endorsing psychiatric symptoms (Cummins et al., 2014), high rates of mental illness were evident among our veterans who used e-cigarettes. In contrast, those using e-cigarettes were less likely than those not using e-cigarettes to report substance use disorders, and alcohol use disorder in particular. Interestingly, when the sample was parsed into individuals with dual diagnosis, substance use disorder only, or mental health disorders only, only 12.1% (4 out of 33) of individuals with substance use disorder only reported current e-cigarette use, compared with 45.1% (23 out of 51) of those with mental health disorders only. This was somewhat surprising in light of recent evidence of increased e-cigarette use among patients with opioid dependence (Stein et al., 2015), which the authors attributed in part to the closed social environments of substance abuse clinics. Like individuals with severe mental illness, those with alcohol use disorders are disproportionately affected by smoking; two-thirds to three-quarters of these individuals smoke, smoke more heavily, have higher nicotine dependence, and only 8–17% quit successfully (Mackowick et al., 2012). Given that e-cigarette use appears to be associated with lower nicotine dependence (Etter & Eissenberg, 2015), e-cigarettes may be less appealing to those with alcohol use disorders, who tend to be

more heavily dependent. This inverse relationship between substance use disorders and e-cigarette use warrants further exploration in future studies.

Older age at smoking initiation was associated with e-cigarette use, with those currently using e-cigarettes being more likely to have begun smoking after age 20. It is possible that due to relatively shorter length of exposure and habituation to smoking these individuals may be less heavily nicotine dependent. Given that use of e-cigarettes tends to be associated with lower levels of dependence (Etter & Eissenberg, 2015), this may explain why smokers who began smoking after age 20 are more likely to use e-cigarettes. Logistic regression analyses confirm that observed motivational differences between those using and not using e-cigarettes (e.g., reducing harm to others, using e-cigarette in non-smoking locations, family/friends' preferences, etc.) remain significant after controlling for age of smoking initiation and mental health disorders, suggesting these differences may be directly related to e-cigarette use.

Similar to what has been observed in the general population of smokers, the majority of individuals currently using e-cigarette in our sample also smoked tobacco cigarettes, (86.2% in our sample vs. 80%) (Dawkins et al., 2013). In contrast to previous reports that e-cigarettes substantially reduce cigarette consumption and can elicit lasting abstinence from tobacco (Hummel et al., 2015; Polosa et al., 2011; Caponnetto et al., 2013b), and although participants in our sample indicated they may use e-cigarettes to help them reduce smoking (22.9%), limit other tobacco use (21.2%), or quit smoking entirely (9.4%), only a very small percentage of respondents indicated e-cigarettes had actually enabled them to quit smoking (4.8% of total sample; 6.9% of those currently using e-cigarettes). This contrasts starkly with recent research in the general population in which a large percentage indicated e-cigarettes helped them avoid smoking for several weeks (74%) to months (57%), with 89.4% of current and past smokers responding "very much so" to the statement "e-cigarettes helped me to stop smoking" (Dawkins et al., 2013). This discrepancy warrants further studies designed to examine the effects of e-cigarette use among smokers with mental health conditions and substance use disorders.

## Limitations

Several limitations should be taken into consideration when interpreting our findings. As is the case with any survey data, our results are cross-sectional and therefore causal relationships cannot be demonstrated. We utilized a convenience sample of veterans presenting to substance use and mental health clinics at the VA in Connecticut and may not represent VA service users in all geographical areas. We relied on self-reported mental health and substance use conditions, which may not completely capture the true psychiatric diagnostic picture. In addition, we did not have participants identify specific unique substance use disorders (e.g., cocaine, opiate, cannabis, etc.) as e-cigarette use may differ among people using these different substances. Given our primary interest in veterans who were currently using e-cigarettes, we did not directly assess e-cigarette perceptions and motivations among those who did not currently use e-cigarettes, but had in the past. Notwithstanding these limitations, these results provide an initial insight into current e-



cigarettes use and perceptions, motivations and behavior regarding e-cigarettes among VA patients with mental health and substance use disorders.

Consistent with previous literature, this sample indicated perceived reduced harm associated with e-cigarette use (Pearson et al., 2012); however this was not matched by reports of past success reducing or quitting smoking with e-cigarettes. It should be noted, however, that conclusions regarding reducing or quitting smoking should be interpreted with caution, as our data rely entirely on participant self-report. Given current controversy regarding the relative risks and merits of e-cigarettes as a potential tool for harm reduction and/or smoking cessation, and scant existing evidence regarding these questions, future research should examine outcomes associated with long-term e-cigarette use using toxicological methods. In particular, this should be examined among veterans with mental health and substance use disorders, especially severe mental illness, as these groups tend to have higher smoking rates than the general population, greater barriers to smoking cessation treatment, and less success quitting smoking (Lasser et al., 2000; Cook et al, 2014; Hartz et al., 2014; Vanable et al., 2003; Prochaska & Grana, 2014; Heyler et al., 1998).

## Conclusion

E-cigarette use was common among these veterans with mental health and/or substance use disorders, who held generally positive perceptions of e-cigarettes and were motivated to use them to reduce harm and improve social acceptance. Rates of dual use of e-cigarettes and traditional cigarettes were high and e-cigarette use was not associated with reports of increased success quitting smoking, as similar quit rates were observed among those who did and did not currently use e-cigarettes. Rigorous research and improved knowledge regarding risks and benefits of e-cigarette use in this population are urgently needed.

## Acknowledgments

### FUNDING

Dr. Hefner is supported by the VA Connecticut Healthcare System / VISN1 MIRECC and Yale University. Research reported in this publication was supported by the Office of Academic Affiliations, Advanced Fellowship Program in Mental Illness Research Education Clinical, Centers (MIRECC), Department of Veterans Affairs, and the National Institute on Drug Abuse of the National Institutes of Health under Award Number P50DA036151. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. Since Dr. Hefner is an employee of the U.S. Government and contributed to the manuscript as part of her official duties, the work is not subject to U.S. copyright.

## References

- Benowitz N. Emerging nicotine delivery products. Implications for public health. *Annals of the American Thoracic Society*. 2014; 11(2):231–235. DOI: 10.1513/AnnalsATS.201312-433PS [PubMed: 24575992]
- Bullen C, Howe C, Laugesen M, McRobbie H, Parag V, Williman J, Walker N. Electronic cigarettes for smoking cessation: A randomized controlled trial. *Lancet*. 2013; 382:1629–1637. DOI: 10.1016/S0140-6736(13)61842-5 [PubMed: 24029165]
- Camenga DR, Cavallo DA, Kong G, Morean ME, Connell CM, Simon P, Bulmer SM, Krishnan-Sarin S. Adolescents' and young adults' perceptions of electronic cigarettes for smoking cessation: A focus group study. *Nicotine & Tobacco Research*. 2015; 17(10):1235–1241. DOI: 10.1093/ntr/ntv020 [PubMed: 25646346]

- Caponnetto P, Campagna D, Cibella F, Morjaria JB, Caruso M, Russo C, Polosa R. Efficiency and Safety of an eElectronic CigaAreTte (ECLAT) as tobacco cigarettes substitute: A prospective 12-month randomized control design study. *Public Library of Science One*. 2013a; 8(6):e66317.doi: 10.1371/journal.pone.0066317 [PubMed: 23826093]
- Caponnetto P, Auditore R, Russo C, Cappello GC, Polosa R. Impact of an electronic cigarette on smoking reduction and cessation in schizophrenic smokers: A prospective 12-month pilot study. *International Journal of Environmental Research and Public Health*. 2013b; 10(2):446–461. DOI: 10.3390/ijerph10020446 [PubMed: 23358230]
- Centers for Disease Control. Smoking-attributable mortality, years of potential life lost, and productivity losses – United States, 2000–2004. *Morbidity and Mortality Weekly Report*. 2008; 57:1226–1228. [PubMed: 19008791]
- Cook BL, Wayne GF, Kafli EN, Liu Z, Shu C, Flores M. Trends in smoking among adults with mental illness and association between mental health treatment and smoking cessation. *JAMA: The Journal of the American Medical Association*. 2014; 311(2):177–182. DOI: 10.1001/jama.2013.284985
- Cummins SE, Zhu S-H, Tedeschi GJ, Gamst AC, Myers MG. Use of e-cigarettes by individuals with mental health conditions. *Tobacco Control*. 2014; 23(Suppl 3):iii48–iii53. DOI: 10.1136/tobaccocontrol-2013-051511 [PubMed: 24824516]
- Dawkins LJ, Turner J, Roberts A, Soar K. ‘Vaping’ profiles and preferences: An online survey of electronic cigarette users. *Addiction*. 2013; 108(6):1115–1125. [PubMed: 23551515]
- Dutra LM, Glantz SA. E-cigarettes and conventional cigarette use among US adolescents: A cross-sectional study. *The Journal of the American Medical Association Pediatrics*. 2014; 168(7):610–617. DOI: 10.1001/jamapediatrics.2013.5488 [PubMed: 24604023]
- Elam M. Nicorette reborn? E-cigarettes in light of the history of nicotine replacement technology. *The International Journal of Drug Policy*. 2015; 26(6):536–542. DOI: 10.1016/j.drugpo.2015.02.002 [PubMed: 25801478]
- Emery, S. It’s not just message exposure anymore: A new paradigm for health media research. Paper presented at the Johns Hopkins Bloomberg School of Public Health; Baltimore MD. 2013.
- Etter JE, Eissenberg T. Dependence levels in users of electronic cigarettes, nicotine gums, and tobacco cigarettes. *Drug and Alcohol Dependence*. 2015; 147:68–75. DOI: 10.1016/j.drugaldep.2014.12.007 [PubMed: 25561385]
- Franck C, Budlovsky T, Windle SB, Filion KB, Eisenberg MJ. Electronic cigarettes in North America: History, use and implications for smoking cessation. *Circulation*. 2014; 129(19):1945–1952. DOI: 10.1161/CIRCULATIONAHA.113.006416 [PubMed: 24821825]
- Green-Shortridge TM, Britt TW, Castro CA. The stigma of mental health problems in the military. *Military Medicine*. 2007; 172(2):157–161. DOI: 10.7205/MILMED.172.2.157 [PubMed: 17357770]
- Hajek P. Electronic cigarettes have a potential for huge public health benefit. *BioMed Central Medicine*. 2014; 12:225.doi: 10.1186/s12916-014-0225-z
- Hartz SM, Pato CN, Medeiros H, Cavazos-Rehg P, Sobell JL, Knowles JA, Bierut LJ, Pato MT. Comorbidity of severe psychotic disorders with measures of substance use. *Journal of the American Medical Association Psychiatry*. 2014; 71(3):248–254. DOI: 10.1001/jamapsychiatry.2013.3726 [PubMed: 24382686]
- Heyler AJ, Brehm WT, Perino L. Economic consequences of tobacco use for the Department of Defense, 1995. *Military Medicine*. 1998; 163(4):217–221. [PubMed: 9575765]
- Hummel K, Hoving C, Nagelhout GE, de Vries H, van den Putte B, Candel MJJM, Borland R, Willemsen MC. Prevalence and reasons for using electronic cigarettes among smokers: Findings from the International Tobacco Control (ITC) Netherlands Study. *The International Journal of Drug Policy*. 2015; 26(6):601–608. DOI: 10.1016/j.drugpo.2014.12.009 [PubMed: 25582280]
- Jamal A, Agaku IT, O’Connor E, King BA, Kenemer JB, Neff L. Current cigarette smoking among adults—United States, 2005–2013. *Morbidity and Mortality Weekly Report*. 2014; 63(47):1108–1112. [PubMed: 25426653]
- Kandel ER, Kandel DB. A molecular basis for nicotine as a gateway drug. *New England Journal of Medicine*. 2014; 371(10):932–943. DOI: 10.1056/NEJMsa1405092 [PubMed: 25184865]

- Kong G, Morean ME, Cavallo DA, Camenga DR, Krishnan-Sarin S. Reasons for electronic cigarette experimentation and discontinuation among adolescents and young adults. *Nicotine & Tobacco Research*. 2015; 17(7):847–854. DOI: 10.1093/ntr/ntu257 [PubMed: 25481917]
- Lasser K, Boyd JW, Woolhandler S, Himmelstein DU, McCormick D, Bor DH. Smoking and mental illness: A population-based prevalence study. *JAMA: The Journal of the American Medical Association*. 2000; 284(20):2606–10. DOI: 10.1001/jama.284.20.2606 [PubMed: 11086367]
- Leventhal AM, Strong DR, Kirkpatrick MG, Unger JB, Sussman S, Riggs, ... Audrain-McGovern J. Association of electronic cigarette use with initiation of combustible tobacco product smoking in early adolescence. *JAMA: The Journal of the American Medical Association*. 2015; 314(7):700–707. DOI: 10.1001/jama.2015.8950 [PubMed: 26284721]
- Li JC, Bullen C, Newcombe R, Walker N, Walton D. The use and acceptability of electronic cigarettes among New Zealand smokers. *The New Zealand Medical Journal*. 2013; 126(1375):48–57. [PubMed: 23824024]
- Mackowick KM, Lynch M-J, Weinberger AH, George TP. Treatment of tobacco dependence in people with mental health and addictive disorders. *Current Psychiatry Reports*. 2012; 14(5):478–485. DOI: 10.1007/s11920-012-0299-2 [PubMed: 22821177]
- Meija AB, Ling PM, Glantz SA. Quantifying the effects of promoting smokeless tobacco as a harm reduction strategy in the USA. *Tobacco Control*. 2010; 19:297–305. DOI: 10.1136/tc.2009.031427 [PubMed: 20581427]
- McRobbie H, Bullen C, Hartmann-Boyce J, Hajek P. The Cochrane Collaboration. Electronic cigarettes for smoking cessation and reduction (Review). *Cochrane Database Systems*, Rev 12. 2014; doi: 10.1002/14651858.CD010216.pub2
- Pearson JL, Richardson A, Niaura RS, Vallone DM, Abrams DB. E-cigarette awareness, use, and harm perceptions in U.S. Adults. *The American Journal of Public Health*. 2012; 102(9):1758–1766. DOI: 10.2105/AJPH.2011.300526 [PubMed: 22813087]
- Peters EN, Harrell PT, Hendricks PS, O’Grady KE, Pickworth WB, Voci FJ. Electronic cigarettes in adults in outpatient substance use treatment: Awareness, perceptions, use, and reasons for use. *The American Journal on Addictions*. 2015; 24:233–239. DOI: 10.1111/ajad.12206 [PubMed: 25809200]
- Polosa R, Caponnetto P, Morjaria JB, Papale G, Campagna D, Russo C. Effect of an electronic nicotine delivery device (e-Cigarette) on smoking reduction and cessation: A prospective 6-month pilot study. *BioMed Central Public Health*. 2011; 11:786.doi: 10.1186/1471-2458-11-786 [PubMed: 21989407]
- Prochaska J, Grana R. E-cigarette use among smokers with serious mental illness. *Public Library of Science One*. 2014; 9(11):e113013.doi: 10.1371/journal.pone.0113013 [PubMed: 25419703]
- Quit in Time – Smoking Cessation. [Accessed July 23, 2015] Quit smoking: Impact on anxiety disorders. Available at: <http://www.quitintime.com/quit-smoking-anxiety-disorders/> Updated 2011
- Rosenheck, RA. Institute of Medicine Committee on Crossing the Quality Chasm: Adaptation for Mental Health and Substance Abuse. Improving the Quality of Health Care for Mental and Substance-use Conditions. Washington DC: National Academies Press; 2004. Mental health and substance abuse services for Veterans: Experience with mental health performance evaluation in the Department of Veterans Affairs; p. 423-482.
- Smokeless Delite. [Accessed July 23, 2015] Electronic cigarette may reduce depression. Available at: <http://www.smokelessdelite.com/electronic-cigarettes-reduce-depression/> Updated 2012
- Stein MD, Caviness CM, Grimone K, Audet D, Borges A, Anderson BJ. E-cigarette knowledge, attitudes, and use in opioid dependent smokers. *Journal of Substance Abuse Treatment*. 2015; 52:73–77. DOI: 10.1016/j.jsat.2014.11.002 [PubMed: 25483740]
- U.S. Department of Health and Human Services. The Health Consequences of Smoking: 50 Years of Progress. A Report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2014. Retrieved from <http://www.surgeongeneral.gov/library/reports/50-years-of-progress/>

Vanable PA, Carey MP, Carey KB, Maisto SA. Smoking among psychiatric outpatients: Relationship to substance use, diagnosis, and illness severity. *Psychology of Addictive Behaviors*. 2003; 17(4): 259–265. [PubMed: 14640821]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

**Table 1**

Demographic and Clinical Characteristics by Current E-cigarette Use

Characteristic	Total Sample (N=188)		E-cigarette Use (n=58, 30.9%)		No E-cigarette Use (n=130, 69.1%)		EC Use vs. No EC Use $\chi^2$ (df), p-value
	n	%	n	%	n	%	
Age (years)							3.22 (2), p=.200
18-30	15	8.0%	7	12.1%	8	6.2%	
31-50	44	23.4%	16	27.6%	28	21.5%	
51+	129	68.6%	35	60.3%	94	72.3%	
Sex /							0.32 (1), p=.574
Male	170	90.4%	50	86.2%	120	92.3%	
Female	15	8.0%	6	10.3%	9	6.9%	
Race/Ethnicity							1.05 (3), p=.788
Caucasian	101	53.7%	32	55.2%	69	53.1%	
Black/African American	70	37.2%	21	36.2%	49	37.7%	
Hispanic/Latino	8	4.3%	2	3.4%	6	4.6%	
Other	7	3.7%	1	1.7%	6	4.6%	
Level of Education							4.24 (2), p=.515
High School/GED or less	84	44.7%	22	37.9%	62	47.7%	
Some College	77	41.0%	25	43.1%	52	40.0%	
Associate's Degree or greater	27	14.4%	11	19.0%	16	12.3%	
Any Mental Health Diagnosis	155	82.4%	54	93.1%	101	77.7%	5.56 (1), p=.018
PTSD	83	44.1%	31	53.4%	52	40.0%	2.42 (1), p=.120
Bipolar Disorder	46	24.5%	20	34.5%	26	20.0%	3.80 (1), p=.051
Depression	75	39.9%	22	36.2%	53	40.8%	0.04 (1), p=.837
Anxiety Disorder	67	35.6%	21	34.4%	46	35.4%	0.00 (1), p=1.000
Personality Disorder	11	5.9%	1	1.7%	10	7.7%	1.62 (1), p=.203
Schizophrenia	21	11.2%	4	6.9%	17	13.1%	0.98 (1), p=.321
Severe Mental Illness	61	32.4%	21	36.2%	40	30.8%	.32 (1), p=.571
Any Substance Use Disorder	137	72.9%	35	60.3%	102	78.5%	5.77 (1), p=.016
Alcohol Use Disorder	92	48.9%	19	32.8%	73	56.2%	7.87 (1), p=.005
Other Substance Use Disorder	99	52.7%	28	48.3%	71	54.6%	.42 (1), p=.518

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Characteristic	Total Sample (N=188)	E-cigarette Use (n=58, 30.9%)	No E-cigarette Use (n=130, 69.1%)	EC Use vs. No EC Use $\chi^2$ (df), p-value			
Substance Use Only (No MHC)	33	17.6%	4	6.9%	29	22.3%	5.56 (1), p=.018
MH Diagnosis Only (No SUD)	51	27.1%	23	39.7%	28	21.5%	5.77 (1), p=.016
Dual Diagnosis (SUD + MHC)	104	55.3%	31	53.4%	73	56.2%	.03 (1), p=.853

Note. EC = E-cigarette; GED = General Educational Development degree; PTSD = Posttraumatic Stress Disorder, MHC = Mental Health Condition; SUD = Substance Use Disorder.  
 3 participants declined to disclose their sex.

**Table 2**

Smoking History by Current E-cigarette Use

	Total Sample (N=188)		E-cigarette Use (n=58, 30.9%)		No E-cigarette Use (n=130, 69.1%)		EC Use vs. No EC Use $\chi^2$ (df) (p-value)
	n	%	n	%	n	%	
<b>Initiation of Smoking</b>							
Started smoking age 10-20	155	82.4%	41	70.7%	114	87.7%	7.31 (1), p=.007
Started smoking age 20+	30	16.0%	16	27.6%	14	10.8%	
<b>Smoking Frequency</b>							
Smoke Cigarettes Daily	137	72.9%	43	74.1%	94	72.3%	4.91 (2), p=.086
Smoke Cigarettes Some Days	34	18.1%	7	12.1%	27	20.8%	
No cigarettes	13	6.9%	7	12.1%	6	4.6%	
<b>Smoking Quantity</b>							
Smoke <1 PPD	98	52.1%	32	55.2%	66	50.8%	2.75 (2), p=.432
Smoke 1 PPD	72	38.3%	19	32.8%	53	40.8%	
Smoke 2 or more PPD	9	4.8%	2	3.4%	7	5.4%	
<b>Money Spent Weekly on Smoking</b>							
\$0	12	6.4%	8	13.8%	4	3.1%	9.89 (3), p=.020
\$10-30	85	45.2%	29	50.0%	56	43.1%	
\$30-60	64	34.0%	12	20.7%	42	32.3%	
\$60+	35	18.6%	9	15.5%	26	20.0%	
<b>Motivation to Quit Smoking</b>							
Very motivated	53	28.2%	13	22.4%	40	30.8%	7.47 (2), p=.058
Somewhat motivated	91	48.4%	31	53.4%	60	46.2%	
Not motivated	33	17.6%	8	13.8%	25	19.2%	
<b>Quit Attempts</b>							
Never Tried to Quit	22	11.7%	6	10.3%	16	12.3%	0.89 (3), p=.827
1-4 Past Quit Attempts	98	52.1%	33	56.9%	65	50.0%	
5-10 Past Quit Attempts	33	17.6%	9	15.5%	24	18.5%	
10+ Past Quit Attempts	33	17.6%	9	15.5%	24	18.5%	
Quit Attempt in Past 12 months	99	52.7%	27	46.6%	72	55.4%	0.31 (1), p=.577
Tried to Quit by Using EC	68	36.2%	25	43.1%	43	33.1%	1.34 (1), p=.247

	Total Sample (N=188)		E-cigarette Use (n=58, 30.9%)		No E-cigarette Use (n=130, 69.1%)		EC Use vs. No EC Use $\chi^2$ (df) (p-value)
	n	%	n	%	n	%	
Successfully Quit by Using EC	9	4.8%	4	6.9%	5	3.8%	0.28 (1), p=.593
<i>Quit Attempt Using...</i>							
Nicotine Replacement	121	64.4%	43	74.1%	78	60.0%	2.91 (1), p=.088
Smokeless Tobacco Products	18	9.6%	8	13.8%	10	7.7%	1.09 (1), p=.296
Counseling	52	27.7%	14	24.1%	38	29.2%	0.297 (1), p=.586
Cold Turkey	23	12.2%	14	24.1%	9	6.9%	9.52 (1), p=.002
Prefer Menthol Cigarettes? (Yes)	115	61.2%	36	62.1%	79	60.8%	0.05 (1), p=.976

Note. EC = E-cigarette; PPD = Packs Per Day.



**Table 3**

Perceptions of E-cigarettes by Current E-cigarette Use

	All Exposed <sup>1</sup> (n=170)		E-cigarette Use (n=54, 31.8%)		No E-cigarette Use (n=116, 68.2%)		EC Use vs. No EC Use $\chi^2$ (df) (p-value)
	n	%	n	%	n	%	
First Exposure to EC							1.85 (4), p=0.762
TV/Radio	64	37.6%	17	31.5%	47	40.5%	
Friend/Family/Coworker	47	27.6%	17	31.5%	30	25.9%	
Internet/Social Media	22	12.9%	8	14.8%	14	12.1%	
Magazine/Newspaper	5	2.9%	1	1.9%	4	3.4%	
Can't remember	32	18.8%	11	20.4%	21	18.1%	
Think EC Are Addictive? (Yes)	96	56.5%	29	53.7%	67	57.8%	0.03 (1), p=0.854
Select all reasons why you use or may use E-Cigarettes							
Save money	74	43.5%	29	53.7%	45	38.8%	2.75 (1), p=.097
Can use in non-smoking areas	71	41.8%	35	64.8%	36	31.0%	15.93 (1), p=.0001
Vapor is less harmful to others	47	27.6%	22	40.7%	25	21.6%	5.86 (1), p=.015
EC reduce the amount I smoke	39	22.9%	15	27.8%	24	20.7%	0.68 (1), p=.408
EC are better for my health	38	22.4%	14	25.9%	24	20.7%	0.32 (1), p=.572
EC reduce other tobacco product use	36	21.2%	18	33.3%	18	15.5%	5.98 (1), p=.014
Less judgment by others	27	15.9%	11	20.4%	16	13.8%	0.75 (1), p=.386
EC allowed me to quit smoking	16	9.4%	7	13.0%	9	7.8%	0.64 (1), p=.424
Friends/family prefer EC	13	7.6%	8	14.8%	5	4.3%	4.37 (1), p=.037
EC taste better/flavor variety	13	7.6%	9	16.7%	4	3.4%	7.34 (1), p=.007
EC set a better example for others	4	2.4%	2	3.7%	2	1.7%	0.06 (1), p=.803
Source of most accurate info re: EC?							
Personal physician/clinician	60	35.3%	23	42.6%	37	31.9%	1.41 (1), p=.236
American Lung Association	44	25.9%	12	22.2%	32	27.6%	0.31 (1), p=.579
American Cancer Society	44	25.9%	11	20.4%	33	28.4%	0.86 (1), p=.352
Food and Drug Administration	40	23.5%	11	20.4%	29	25.0%	0.22 (1), p=.640
Veteran's Administration	39	22.9%	12	22.2%	27	23.3%	0.00 (1), p=1.000
Centers for Disease Control	22	12.9%	7	13.0%	15	12.9%	0.00 (1), p=1.000
National Institutes of Health	19	11.2%	5	9.3%	14	12.1%	0.78 (1), p=.780

	All Exposed <sup>1</sup> (n=170)		E-cigarette Use (n=54, 31.8%)		No E-cigarette Use (n=116, 68.2%)		EC Use vs. No EC Use $\chi^2$ (df) (p-value)
	n	%	n	%	n	%	
Internet	18	10.6%	8	14.8%	10	8.6%	0.91 (1), p=.340
Friend/family member	16	9.4%	3	5.6%	13	11.2%	0.80 (1), p=.372
Tobacco industry	14	8.2%	2	3.7%	12	10.3%	1.36 (1), p=.243
Chain of Command	9	5.3%	3	5.6%	6	5.2%	0.00 (1), p=1.000
Should EC be regulated like cigarettes and other tobacco products? (Yes)	93	54.7%	22	40.7%	71	61.2%	4.84 (1), p=.028

Note. EC = E-cigarette.

<sup>1</sup>Participants who indicated they had never heard of e-cigarettes (n = 18) were omitted from these analyses.