

## BRIEF REPORT

# Electronic Cigarette Awareness, Use History, and Expected Future Use Among Hospitalized Cigarette Smokers

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## ABSTRACT

**Introduction:** E-cigarette use has surged during the past few years while the debate about the product's safety and efficacy for smoking cessation continues. Little is known about the characteristics that distinguish users from nonusers; in this study, we aimed to elucidate these characteristics among hospitalized smokers, a heretofore unstudied population.

**Methods:** Cross-sectional data were collected from cigarette smokers via hospital bedside interviews. Participants reported e-cigarette use status, reasons for use (if used), e-cigarette advertising exposure, expected likelihood of future e-cigarette use, desire to quit smoking, and demographic characteristics.

**Results:** Of the 657 English-speaking hospitalized smokers who provided data, 97% reported awareness of e-cigarettes and 46.4% reported e-cigarette use, with 20% reporting use in the previous 30 days. Previous e-cigarette use was significantly more likely among those who were White (odds ratio [OR] = 4.7; confidence interval [CI] = 3.2–6.7), were married/had a domestic partner (OR = 1.5; CI = 1.0–2.2), had more than a high school education (OR = 1.7; CI = 1.1–2.7), had e-cigarette advertising exposure (OR = 1.6; CI = 1.1–2.4), and were younger (OR = 1.3; CI = 1.1–1.5). Expected likelihood of future e-cigarette use was high and positively correlated with desire to quit smoking (Spearman's  $\rho = .18$ ,  $p < .0001$ ).

**Conclusions:** Rates of awareness and use of e-cigarettes may be elevated among hospitalized smokers, with more use reported among those who were White, younger, more educated, in a relationship, and exposed to e-cigarette advertising. The association between desire to quit smoking and expected likelihood of future e-cigarette use suggests that cigarette smokers may perceive e-cigarettes as a useful cessation aid.

## INTRODUCTION

Despite recent declines in use, cigarette smoking remains the leading cause of preventable morbidity and mortality in the United States with a current rate of 18% (National Center for Health Statistics, 2013). With evidence that the population of American smokers is becoming increasingly resistant to treatment (Emery, Gilpin, Ake, Farkas, & Pierce, 2000; Irvin, Hendricks, & Brandon, 2003) and existing smoking cessation treatments yielding modest abstinence rates (Fiore et al., 2008), there is a need for acceptable, safer alternatives to tobacco smoking and further options for cessation therapies. Some experts believe this need may be met in part by electronic cigarettes (hereinafter

e-cigarettes, also known as Electronic Nicotine Delivery Systems-ENDS) (Etter, 2013).

E-cigarettes have emerged rapidly over the last few years, with 3% of the U.S. population reporting use in 2010 (Pearson, Richardson, Niaura, Vallone, & Abrams, 2012). Rising prevalence is evident by the increasing popular press coverage and Internet forums on e-cigarettes, as well as scientific scrutiny (Bullen et al., 2013; Cobb & Abrams, 2011; Cobb, Byron, Abrams, & Shields, 2010; Dawkins, Turner, Hasna, & Soar, 2012; Eissenberg, 2010; Etter & Bullen, 2011; Etter, Bullen, Flouris, Laugesen, & Eissenberg, 2011; Regan, Promoff, Dube, & Arrazola, 2013; Wagener, Siegel, & Borrelli, 2012; Yamin, Bitton, & Bates, 2010). Although touted as potential cessation aids and as harm-reduction products for continuing tobacco

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users (Etter, 2013), e-cigarettes are not without controversy. Numerous questions have been raised about e-cigarettes' efficacy as cessation aids and safety for users (Avdolic & Murin, 2012; Chen, 2013; Cobb et al., 2010; Williams, Villarreal, Bozhilov, Lin, & Talbot, 2013).

Knowledge of the profiles of current and potential users of e-cigarettes is limited. In a sample of 2,649 U.S. adult smokers and nonsmokers, awareness of e-cigarettes was reported to be 40.2% (Pearson et al., 2012). The prevalence of e-cigarette use among adult smokers in the United States has been reported to be between 11% and 21% (Adkison et al., 2013; King, Alam, Promoff, Arrazola, & Dube, 2013; Pearson et al., 2012; Popova & Ling, 2013; Regan et al., 2013). In a recent survey, 73% ( $n = 104$ ) of e-cigarette users reported using the product for smoking cessation (Foulds, Veldheer, & Berg, 2011) despite the lack of evidence supporting e-cigarette efficacy as quitting aids (Caponnetto, Polosa, Russo, Leotta, & Campagna, 2011). While e-cigarette use has been studied in a variety of cohorts, hospitalized cigarette smokers have not been evaluated. Hospitalized smokers are of particular interest because they are over-represented in hospital populations (Benowitz et al., 2009; California Department of Health Services & Section, 2006; Division of Chronic Disease Prevention and Control, 2005; Katz, Goldberg, Smith, & Trick, 2008; Reid et al., 2010; Shields, 2007) and, having received requisite smoking cessation messages during hospitalization (Freund et al., 2008; The Joint Commission, 2013), they are more likely to be motivated to quit (Katz et al., 2008; Reid et al., 2010). Therefore, they may be more likely to consider e-cigarette use. Given the recent proliferation of this product, information on the perceptions and use of e-cigarettes in this high-risk population can add evidence to the ongoing discussions regarding e-cigarette efficacy, safety, and regulation. This paper presents baseline data from an observational study of hospitalized cigarette smokers describing their reported awareness, use, reasons for use, e-cigarette advertising exposure, and expected likelihood of future e-cigarette use, as well as their desire to quit smoking cigarettes.

## METHODS

English-speaking cigarette smokers between the ages of 19 and 80, with a stable phone number, admitted for overnight stay at a 1046-bed urban academic center tertiary care hospital in the southeast United States were eligible for recruitment to this study; maternity, locked psychiatric and some intensive care units were excluded. Admission data on smoking status identified smokers who were visited by staff providing brief smoking cessation advice between December 2012 and May 2013. All patients meeting eligibility criteria were asked if they were interested in hearing about a research study. Those patients indicating interest were informed about and recruited to a 1-year follow-up observational study. This report represents preliminary results of baseline data from the sample recruited during the first 6 months of the study. Structured assessments, completed via bedside interview after participants provided written informed consent, determined awareness (yes/no) and use of electronic cigarettes (yes/no and use in last 30 days), exposure to e-cigarette advertising (yes/no), expected likelihood of future e-cigarette use, and desire to quit smoking (both using response scale; 1–10 = highest). Only those who reported e-cigarette use were asked their *primary reason* for

use by choosing one response among four options (help with quitting, less risky product long term, use in nonsmoking areas, or do not know). Demographics were assessed that included gender, age (categorized into five, 10-year age groups starting with 19–29 and ending with 60 and older), relationship status (married/living with a domestic partner or single), and educational attainment (less than a high school degree, high school degree/general equivalency diploma (GED), more than a high school degree). The study was approved by the University of Alabama at Birmingham's Institutional Review Board.

Descriptive analyses were performed to present characteristics of the study cohort overall and stratified by e-cigarette use status (dichotomized as *ever* vs. *never* use and trichotomized as *recent* vs. *past* vs. *never* use). Chi-square tests, *t* tests, or analyses of variance (ANOVAs) were performed to estimate associations of e-cigarette use with demographic variables, e-cigarette advertising exposure, expected likelihood of future e-cigarette use, desire to quit smoking, and for *recent/past* users only, reasons for use. These same variables were tested for their adjusted association with dichotomized e-cigarette use status using a multivariable logistic regression model and with trichotomized e-cigarette use status using a cumulative logistic model. For participants reporting *ever* use of e-cigarettes, bivariate associations of reasons for e-cigarette use with demographic variables, e-cigarette advertising exposure, expected likelihood of future e-cigarette use, and desire to quit smoking were determined by performing Chi-square tests or ANOVAs. Expected likelihood of future e-cigarette use was examined as an outcome by categorizing into low, medium, high, and extreme likelihood to facilitate meaningful results; cumulative logistic regression models evaluated the adjusted association of expected likelihood of future e-cigarette use with demographic variables, dichotomized use status, and e-cigarette advertising exposure. Lastly, nonparametric Spearman's rank-order correlation coefficient was estimated to examine the correlation between expected likelihood of future e-cigarette use and desire to quit smoking as the two measures had skewed distributions; the correlation estimation was replicated for men and women separately.

## RESULTS

Over 72% of smokers approached agreed to participate in the 1-year study. Cross-sectional data for this study were provided by 657 hospitalized smokers, 97% of whom were aware of e-cigarettes and 45% ( $n = 291$ ) reported having used them, with 20% reporting recent use. Table 1 displays descriptive characteristics of the sample by e-cigarette use status. Table 2 displays results of the multivariable logistic models predicting e-cigarette use status. Results from a multivariate logistic regression model indicate that e-cigarette *ever* (vs. *never*) use was more likely among Whites versus Blacks, among those who were married/living with a domestic partner versus single, among those with more than a high school degree versus those with less than a high school degree, among those exposed to advertising, and among younger age versus older age groups. A cumulative multivariate logistic regression model comparing *recent* versus *past* vs. *never* use revealed that both recent and past use was more likely among Whites, younger age groups, and those who were married/living with a domestic partner.

Among those who reported *ever* use, reasons for use were not found to differ by race ( $p = .253$ ), relationship status

**Table 1.** Patient Characteristics and E-Cigarette Use Among Hospitalized Patients in a Tertiary-Care Academic Center Hospital

	<i>n</i> (%)	E-cigarette use status %			Bivariate comparisons	
		Recent	Past	Never	<i>p</i> value <sup>a</sup>	<i>p</i> value <sup>b</sup>
Gender						
Male	366 (56)	24.0	23.5	52.5	.076	.578
Female	291 (44)	17.2	27.2	54.6		
Race <sup>c</sup>						
White	358 (57)	29.6	32.7	37.7	<.001	<.001
Black	274 (43)	9.9	15.7	74.5		
Relationship status						
Married/domestic partner	206 (32)	23.8	32.0	44.2	.005	.002
Single <sup>d</sup>	444 (68)	20.1	22.5	57.4		
Education						
<High school	156 (24)	13.5	25.0	61.5	.020	.016
High school grad or GED	253 (39)	21.0	24.9	54.2		
>High school	241 (37)	26.6	26.6	46.9		
Reason for use <sup>e</sup> ( <i>n</i> = 291)						
Help to quit smoking	181 (62)	45.9	54.1		.518	
Use in nonsmoking area	74 (26)	44.6	55.4			
Less risky product long term	36 (12)	55.6	44.4			
Exposure to advertising						
Yes	485 (74)	22.1	27.8	50.1	.011	.003
No	171 (26)	18.1	18.7	63.2		
Age (years)						
19–29	93 (14)	31.2	30.1	38.7	<.001	<.001
30–39	128 (20)	20.3	35.2	44.5		
40–49	149 (23)	22.2	22.2	55.7		
50–59	183 (28)	16.4	23.5	60.1		
60–80	93 (14)	18.3	15.1	66.7		
Mean ( <i>SD</i> )						
Likelihood of future use <sup>f</sup>	657	7.3 (3.1)	6.6 (3.2)	6.8 (3.2)	.141	.715
Desire to quit smoking <sup>f</sup>	657	8.3 (2.6)	8.3 (2.3)	8.4 (2.4)	.873	.629

Note. GED = General Educational Development certificate.

<sup>a</sup>*p* value for recent vs. past vs. never use comparison.

<sup>b</sup>*p* value for ever (recent and past) vs. never use comparison.

<sup>c</sup>Three percentage “other” racial group excluded due to small sample size.

<sup>d</sup>Single includes separated, divorced, widowed, and never married.

<sup>e</sup>Data only available for ever-use participants (past and recent).

<sup>f</sup>1–10 response scale.

(*p* = .532), or education (*p* = .884); however, age, gender, and e-cigarette advertisement exposure were associated with reason for use. Specifically, older users were more likely to report *help to quit smoking* while younger users more often reported *something to use in nonsmoking area* (*df* = 8;  $\chi^2$  = 16.1; *p* = .041). Women were more likely to report e-cigarette use for help to quit smoking cigarettes than men (72.4% vs. 54.8%; *df* = 2;  $\chi^2$  = 11.0; *p* = .004). Almost 15% of those who reported e-cigarette advertisement exposure also reported using e-cigarettes as a less risky product long term versus only 3% of those reporting no advertisement exposure (*df* = 2;  $\chi^2$  = 6.1; *p* = .040).

Reason for use was not associated with expected likelihood of future use (*df* = 2; *F* = 2.6; *p* = .080), but was positively associated with a desire to quit smoking (*df* = 2; *F* = 18.5; *p* < .001). Expected likelihood of future e-cigarette use was high among all three use groups (*past*, *recent*, *never*) with no significant difference among them (*df* = 3;  $\chi^2$  = 27.8; *p* = .065), or across

demographic variables and having seen an ad, with the exception of gender: women reported a higher expected likelihood of future use (median 8 vs. 7; odds ratio [*OR*] = 1.6 [*CI* = 1.2–2.1; *p* = .002]). Desire to quit smoking and expected likelihood of future e-cigarette use were correlated ( $\rho$  = .18; *p* < .001) and with higher correlation for men than women (men:  $\rho$  = .22; *p* < .001; women:  $\rho$  = .11, *p* = .05).

## DISCUSSION

In this study of hospitalized smokers, we found almost universal awareness of e-cigarettes and higher rates of e-cigarette use than previously reported among smokers from the general population (Adkison et al., 2013; King et al., 2013; Pearson et al., 2012; Popova & Ling, 2013; Regan et al., 2013). This is consistent with reports of exponentially increasing awareness

**Table 2.** Multivariable Logistic Regression Models for Characteristics Associated With E-Cigarette Use

	Ever vs. never use			Recent vs. past vs. never use		
	OR	95% CI	p value	OR	95% CI	p value
Gender						
Male vs. female	1.01	0.71, 1.45	.91	1.18	0.85, 1.64	.30
Race <sup>a</sup>						
White vs. Black	4.67	3.24, 6.73	<.001	4.47	3.15, 6.35	<.001
Relationship status						
Married/domestic partner vs. single <sup>b</sup>	1.48	1.02, 2.17	.03	1.32	0.94, 1.86	.10
Education						
>HS vs. <HS	1.68	1.06, 2.66	.02	1.81	1.18, 2.76	.006
HS graduation/GED vs. <HS	1.38	0.87, 2.18	.16	1.42	0.93, 2.18	.10
Exposure to advertising						
Exposure vs. no exposure	1.62	1.08, 2.43	.01	1.45	1.00, 2.11	.04
Age by 10 years						
Younger vs. older	1.33	1.15, 1.52	<.001	1.28	1.12, 1.45	<.001

Note. OR = odds ratio; CI = confidence interval; GED = General Educational Development certificate; HS = high school diploma.

<sup>a</sup>Three percentage “other” racial group excluded due to small sample size.

<sup>b</sup>Single includes separated, divorced, widowed, and never married.

of e-cigarettes among smokers and nonsmokers alike in the United States (Adkison et al., 2013). Reports on which demographic groups are using e-cigarettes are not consistent, perhaps reflecting the variation in participant samples. We found Whites reporting more than double the use of e-cigarettes than Blacks (62.3% vs. 25.7%, respectively), which contrasts with Popova and Ling’s (2013) report of similar prevalence (20.5% vs. 20.2%) among smokers but is less than the difference reported by Pearson et al. (2012) for the Legacy Longitudinal Smoker cohort (7.4% vs. 0.8%). We also found *ever* use highest in those with higher levels of education. Whites and those with more education are likely drawn from higher socioeconomic strata, and such individuals are more likely to adopt innovations (Marketing Charts Staff, 2012); the young are also more likely to adopt technology and may have greater interest in what they believe to be healthy behaviors (Cutler & Lleras-Muney, 2006). Previous studies have yielded mixed results regarding the impact of gender and education on e-cigarette use (Choi & Forster, 2013; Pearson et al., 2012; Regan et al., 2013). Thus, future research is needed to replicate the current findings to determine if they are part of a changing trend, geographically idiosyncratic, or specific to smokers who are hospitalized.

Somewhat surprisingly, we found no relationship between prior e-cigarette use and expected likelihood of future use. This may reflect a ceiling effect as the vast majority of participants indicated very high expected likelihood of future use. The association between desire to quit and expected likelihood of future e-cigarette use is consistent with reports of e-cigarette use as a perceived aid for smoking cessation (Foulds et al., 2011; Vickerman, Carpenter, Altman, Nash, & Zbikowski, 2013). This perception appears to persist despite FDA requirements that e-cigarettes not be marketed as smoking cessation products (U.S. Food and Drug Administration, 2010).

## LIMITATIONS

The findings here are limited to smokers hospitalized in a tertiary care hospital in the southeast United States. Given the

setting for this study, social desirability, especially with respect to desire to quit smoking, may have biased some responses. In addition, respondents were restricted to one reason for use of e-cigarettes from a limited list which restrained options for participant responses. Finally, as these data are cross-sectional, causality cannot be determined.

## CONCLUSIONS

This study describes the prevalence and expected likelihood of future e-cigarette use among a group of smokers with elevated risk for tobacco-related morbidity and mortality who report being motivated to quit smoking cigarettes. The association between desire to quit smoking cigarettes and the expected likelihood of future e-cigarette use, along with help to quit smoking reported most often as the primary reason for previous e-cigarette use, suggests that cigarette smokers view e-cigarettes as helpful quit aids. Additional research is needed to understand how perceptions of e-cigarettes are formed, including the role of advertising exposure, and what drives the differences in e-cigarette use among demographic groups.

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## DECLARATION OF INTERESTS

None declared.

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