

Electronic cigarettes: How confident and effective are allergists, pulmonologists, and primary care physicians in their practice behavior?

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ABSTRACT

Background: There has been a striking increase in electronic cigarette (EC) use in the United States. The beliefs and practices toward ECs among physicians are unknown.

Objective: The purpose of this study was to investigate EC practice patterns among allergists, pulmonologists, and primary care physicians.

Methods: An anonymous survey was sent to physicians. The survey contained 32 questions and addressed issues related to demographics, cessation counseling behaviors, personal use, and knowledge and beliefs about ECs. Statistical analysis was performed by using analysis of variance, the Pearson χ^2 test, Fisher exact test, and logistic regression.

Results: A total of 291 physicians completed the survey (222 primary care physicians, 33 pulmonologists, and 36 allergists) for a response rate of 46%. The allergists asked about tobacco cigarette use as frequently as did the pulmonologists and more than the primary care physicians ($p < 0.001$), but they rarely asked about EC use. The pulmonologists scored highest on self-reported knowledge on ECs, although all the groups answered $<40\%$ of the questions correctly. The allergists did not feel as comfortable about providing EC cessation counseling as did the pulmonologists and primary care physicians ($p < 0.001$). All three groups were equally unlikely to recommend ECs as a cessation tool for tobacco cigarette users.

Conclusion: Allergists lacked knowledge and confidence in providing education and cessation counseling for EC users. As the number of patients who use these products continues to increase, there is an urgent need for all physicians to be comfortable and knowledgeable with counseling about ECs.

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Tobacco use remains the leading preventable cause of death in the United States and globally.¹ Electronic cigarettes (EC) are the most popular tobacco products that have emerged over the past decade, especially among young adults. Vaping refers to the action or practice of inhaling and exhaling the vapor produced by an EC. Data analysis from the 2011–2016 National Youth Tobacco Survey showed a remarkable increase in EC use among youth. Between 2011 and 2015, current users of ECs increased from 1.5% to 16.0% among high school students and from 0.6% to 5.3% among middle school students.² As of 2015, ECs have replaced traditional cigarettes (TC) as the most commonly used tobacco product in youth.² This has prompted heated debate with regard to the safety of ECs. In 2016, the Surgeon General issued a report

that concluded that the drastic increase in EC use represents an emerging public health concern and may provide a gateway for youth to initiate tobacco use.³ However, proponents of ECs argued that ECs are a safer alternative to TC and a useful “harm reduction” model.⁴

In contrast to the extensive knowledge about TCs, health consequences of EC use are still nascent. ECs consist of three primary components: a power source (*i. e.*, lithium battery), heating element, and liquid-containing reservoir. The liquid also contains several components, including solvent (glycerin and/or propylene glycol), flavoring, and nicotine. The resulting aerosol, depending on the solvents and flavored used, can have a large variation in chemicals.^{5,6} A number of studies show the cytotoxic effects of e-liquids (liquids within electronic cigarettes) to human pharyngeal tissues by increasing DNA fragmentation, oxidative stress, and decreasing cell proliferation.⁷ In mice models, EC aerosol is found to increase allergic inflammation by increasing production of T-helper type 2 cytokines (interleukin [IL] 4, IL-5, IL-13), and ovalbumin-specific immunoglobulin E (IgE) production.⁸ Short-term exposure of mice to EC aerosol was associated with lung inflammation and systemic and with pulmonary oxidative stress by altering the endothelial function of the lungs.⁹

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There has been moderate evidence for increased cough and wheeze in adolescents who use ECs and an association with EC use and an increase in asthma exacerbation.¹⁰ In addition, a recent study demonstrated that secondhand EC aerosol exposure was associated with higher odds of an asthma attack (odds ratio [OR] 1.27).¹¹ Physicians have an important role in disease prevention and healthy life style promotion, and, because allergists specialize in the treatment of asthma, their exposure to patients who are using ECs will increase over time. A physician's willingness to engage in prevention counseling is heavily influenced by his or her own knowledge, habits, and beliefs.¹² Allergists, pulmonologists, and primary care physicians all see a significant number of patients with concurrent asthma and tobacco use, including exposure to ECs. The aim of this study was to assess the comfort level and practice patterns of physicians across fields with regard to ECs so that gaps can be identified, which will ultimately allow physicians to provide relevant information and effective counseling to patients who use ECs.

METHODS

This voluntary, anonymous, survey was approved by the institutional review board at The University of Michigan. Written informed consent was not required.

Recruitment

An online survey was sent to internal medicine, pediatric, family medicine, allergy/immunology, and pulmonary physicians at one U.S. academic center (The University of Michigan, Ann Arbor, Michigan) as well as to local private practice allergists in the Ann Arbor and Detroit areas. The survey was sent to both board-certified and board-eligible physicians as well as those in residency or fellowship training. Local private allergists were contacted based on the listing provided by The American Academy of Allergy, Asthma & Immunology member directory. The survey remained open for 6 weeks, from December 2016 to January 2017. A total of two reminder e-mails were sent.

Survey Development

The survey consisted of 32 questions adapted from previously validated surveys, including the National Youth Tobacco Survey and Global Health Professions Student Survey.^{13,2} It also contained newly created questions that were developed and reviewed by us. Five major categories of questions were included: demographics (*i.e.*, age, sex, race and/or ethnicity, job, years since graduating medical school, personal asthma diagnosis), personal use of tobacco products, beliefs on ECs, knowledge about ECs, and cessation practices with TCs and ECs.

Measures

Personal Use of Tobacco Products. The physicians were asked to indicate the frequency of their use of cigarettes, ECs, cigars, hookahs, chewing tobacco, and marijuana. "Over one year ago" indicated lifetime use, "within last year" indicated use in the past year, and "within last month" indicated current use.

Beliefs on EC. The physicians were asked to rate the degree to which cigarette smoking or use of ECs are responsible for causing or worsening various diseases on a 5-point scale (1, not at all responsible; 2, a little responsible; 3, somewhat responsible; 4, moderately responsible; 5, largely responsible). They were also given several statements to assess any potential advantages of ECs compared with TCs: "they can help people quit smoking," "they are less harmful than cigarettes," "they are less addictive than cigarettes," "they can reduce secondhand smoke pollution," "they are less likely to cause cancer," "they are less likely to trigger asthma attacks," and "none, there are no advantages."

Knowledge on EC. The physicians were asked four knowledge questions on EC (1. Percentage of U.S. adults having reported ever trying ECs; 2. The most commonly used tobacco products among U.S. middle and high school students in 2015; 3. Chemicals found in ECs; and 4. Knowledge of vaping). Physicians were also asked to indicate how knowledgeable they think they are about EC, based on a 5-point scale (1, not at all knowledgeable; 2, not so knowledgeable; 3, somewhat knowledgeable; 4, knowledgeable; 5, very knowledgeable.)

Practice on EC Cessation. The physicians were asked to indicate how often they ask about TC and EC use in an office visit, based on a 5-point scale (1, never; 2, rarely; 3, some of the time; 4, most of the time; 5, all the time). Physicians were also asked about their comfort level in counseling patients on cessation of EC, on a 5-point scale (1, not comfortable; 2, not so comfortable; 3, somewhat comfortable; 4, comfortable; 5, very comfortable). They were also asked about how likely they are to recommend EC to patients who want to quit smoking, based on a 5-point scale (1, very unlikely; 2, somewhat unlikely; 3, neutral; 4, somewhat likely; 5, very likely).

Statistical Analyses

Respondent characteristics were examined. Analysis of variance tests were performed to compare differences among personal practice on EC use, perceptions and beliefs about ECs, knowledge of ECs, and degree of disease causation. For binary responses, such as the proportion of physicians who reported conducting

cessation counseling, Pearson χ^2 and Fisher exact tests were used. An ordinal logistic regression model was used to identify factors associated with comfort level in counseling for EC cessation. The model controlled for responder's medical specialty, sex, age, race, and years out of postgraduate training. Because most respondents completed the entire survey, incomplete responses were excluded from analyses in a case-wise manner. Statistical significance was determined by using a two-sided $\alpha = 0.05$. All analyses were performed by using Stata 12 SE (StataCorp, College Station, Texas).

RESULTS

Demographics

Two hundred and ninety-one physicians provided complete responses, for an overall response rate of 46%. A significant number of the participants were ages < 30 years. There was an equal distribution of male and female respondents. Most participants identified as white. The majority of surveyed physicians were primary care physicians (internists, pediatricians, or family medicine physicians) who graduated medical school <5 years ago, and a total of 36 allergists responded (Table 1).

Physicians' Self-Reported Use of Smoking and Tobacco Products

When asked about their personal use of tobacco or smoking products, a significant percentage of physicians reported ever using cigarettes (18%), and an even higher percentage reported ever using marijuana (22%). In contrast, <2% of surveyed physicians reported ever or currently using ECs (Table 2).

Frequency of Screening Cigarette and EC Use in the Office

Physicians across the specialties reported screening cigarette use "some" or "most of the time," but they "rarely" or "never" screened for EC use. The allergists screened for TC use as much as did the pulmonologists, and both more frequently than did primary care physicians. However, neither allergists nor primary care physicians screened for EC use nearly as much as did pulmonologists. ($p < 0.05$) (Fig. 1).

Logistic regression was used to investigate predictors for EC screening. It was found that the pulmonologists were the most likely to screen for ECs, and both the pulmonologists and primary care physicians were more likely to screen for ECs than were the allergists (odds ratio [OR] 5.4 and OR 2.7, respectively; $p < 0.05$). In addition, the older physicians were found to be slightly more likely to screen for ECs (OR 1.06; $p < 0.05$). Race and years since medical school graduation were not significant variables.

Table 1 Baseline characteristics of survey participants

Age	n (%)
<30 y	125 (43)
31–40 y	70 (24)
41–50 y	42 (14)
51–60 y	34 (11)
>61 y	20 (7)
Sex	
Males	160 (55)
Females	131 (45)
Race and/or ethnicity	
White	219 (75)
Asian	63 (21)
Black	1 (0.4)
American Indian	3 (1.0)
Native Hawaiian/PI	1 (0.4)
Other	7 (2.4)
Specialty	
Primary care	222 (76)
Pulmonary	33 (11)
Allergy	36 (12)
Years since medical school graduation	
<5 y	152 (52)
5–10 y	30 (10)
11–20 y	42 (14)
>20 y	67 (23)
Self-reported diagnosis of asthma	
No	250 (86)
Yes	41 (14)

Knowledge on ECs

The physicians were asked to report their knowledge about ECs. The pulmonologists reported knowing the most about ECs compared with the allergists and primary care physicians ($p < 0.001$). The physicians across the specialties answered <40% of questions correctly, with the allergists and pulmonologists scoring higher than the primary care physicians ($p = 0.002$) (Table 3). Logistic regression was used to investigate predictors of knowledge questions answered correctly. It was found that specialty, age, race, and years since medical school graduation were not significant variables.

Perception of Advantages of ECs and Their Roles in Disease Causation

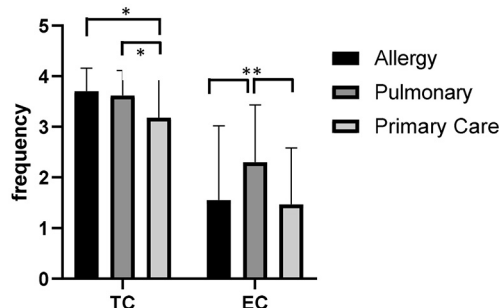
The physicians were asked about potential advantages of TCs compared with cigarettes in several domains: TCs "can help people quit smoking," "are less harmful than cigarettes," "are less addictive than cigarettes," "can reduce secondhand smoke," "are less likely to cause cancer," "are less likely to trigger

Table 2 Prevalence of tobacco use among physicians*

Product	Usage Pattern, <i>n</i> (%)		
	Ever Use	Past Year Use	Past 30 Day Use
Traditional cigarette	53 (18)	3 (1)	2 (0.8)
Electronic cigarette	5 (1.7)	4 (1.4)	1 (0.3)
Chewing tobacco	18 (6)	2 (0.7)	1 (0.3)
Cigars	58 (19)	15 (5.1)	1 (0.3)
Marijuana	66 (22)	6 (2.0)	0 (0)

*An anonymous survey was completed by 291 physicians at one U.S. medical center; the physicians were asked to indicate the frequency of their use of various tobacco and smoking products.

Frequency of Screening TC and EC Use



1 =never; 2=rarely; 3=some of the time; 4=most of the time; 5=all the time

* $p \leq 0.002$

** $p \leq 0.002$

Figure 1. Frequency of screening tobacco cigarette (TC) and electronic cigarette (EC) use. Score 1, never; 2, rarely; 3, some of the time; 4, most of the time; 5, all of the time.

Table 3 Knowledge about electronic cigarettes

	Self-Reported Knowledge Score, mean $\pm$ SD*	Knowledge Questions Correct, % $\#$
Allergy	2.42 $\pm$ 0.92	32
Pulmonary	3.03 $\pm$ 0.84	33
Primary care	2.32 $\pm$ 0.85	27

SD = Standard deviation.

* $p < 0.001$; pulm > allergy = primary care.

$p = 0.002$; allergy = pulm > primary care.

Score of 1 = not at all knowledgeable; 2 = not so knowledgeable; 3 = somewhat knowledgeable; 4 = knowledgeable; 5 = very knowledgeable.

asthma attacks." The majority of the physicians across the specialties believed that ECs can help people quit smoking, although they were skeptical about the claims that ECs are less harmful and less addictive than cigarettes, and less likely to cause cancer or

trigger asthma attacks. There was no difference among the specialties ($p > 0.05$) (Online Supplemental Table 1).

Comfort Level in EC Cessation and Practice on Cigarette Cessation

When asked about the comfort level in providing EC cessation, the allergists reported "not so comfortable." In comparison, the pulmonologists reported a higher comfort level at providing EC cessation counseling than both the allergists and primary care physicians ($p < 0.001$). The physicians across the fields reported that they were unlikely to choose ECs as a smoking cessation aid (Table 4). Logistic regression was used to investigate predictors for the comfort level in EC cessation counseling. It was found that the primary care physicians and pulmonologists were more comfortable at providing EC cessation counseling compared with the allergists (OR 3.1 versus OR 12.7, respectively; $p < 0.05$), whereas age, race, and years since medical school graduation were not significant variables.

DISCUSSION

To to our knowledge, we reported for the first time, the belief, attitudes, knowledge, and practice about ECs among allergists, pulmonologists, and primary care physicians. Our findings indicated that the physicians across specialties lacked knowledge and cessation skills to counsel patients on EC cessation. The allergists screened EC use less frequently, reported less knowledge about EC, and did not feel as comfortable at providing EC cessation counseling compared with pulmonologists and primary care physicians.

It is estimated that as many as 70% of cigarette smokers visit a physician each year¹⁴ and that a counseling intervention as short as 3 minutes can significantly increase cessation rates in cigarette smokers who want to quit.¹⁵ Because ECs are quickly changing the landscape of tobacco use in the United States, it is concerning that our study found that the physicians across the fields "rarely" or "never" screened for EC use. Although the allergists screened EC use as much as

Table 4 Comfort level about e-cigarette (EC) cessation and practice on cigarette cessation

	Comfort Level of Providing EC Cessation*#	Recommend EC as a Cessation tool§¶
Allergy	2.22 (1.25)	1.97 (1.24)
Pulmonary	3.45 (0.99)	1.65 (0.86)
Primary care	2.34 (1.12)	1.73 (0.95)

* $p < 0.001$; *pulm* > *allergy* = *primary*.

#Score of 1, *very uncomfortable*; 2, *not so comfortable*; 3, *somewhat comfortable*; 4, *comfortable*; 5, *very comfortable*.

§ $p = 0.4$; *pulm* = *allergy* = *primary*.

¶Score of 1, *very unlikely*; 2, *somewhat unlikely*; 3, *neutral*; 4, *somewhat likely*; 5, *very likely*.

did primary care physicians, neither screened nearly enough. In one study, nearly 70% of the physicians screen for traditional tobacco use during an office visit, a percentage that is much higher compared with EC screening.¹⁶

The efficacy of ECs as a smoking cessation tool remains uncertain due to limited data from randomized trials.¹⁷ A recent randomized trial in the United Kingdom compared the effectiveness of EC versus nicotine replacement therapy (NRT) in smoking cessation >1 year and concluded that ECs are more effective.¹⁸ Conclusions of meta-analyses may slightly favor their use, although with low certainty and limited knowledge on long-term efficacy.^{17,19} For chronic TC smokers who are unable to quit, some experts argue that ECs may be associated with better health outcomes,²⁰ whereas other experts believe that the benefits of reduced smoking with dual use of ECs are uncertain.²¹ Surveyed physicians across specialties in this study were equally unlikely to recommend TC to cigarette users as a cessation aid.

In light of this evidence, there is no consistent guideline for physicians to recommend the use for or against ECs as a cessation tool for patients who want to quit smoking cigarettes. The American Heart Association recommends that TC use should be discussed for patients for whom evidence-based cessation methods failed or patients who refused to try evidence-based cessation methods²²; the American Society for Clinical Oncology recommends that physicians should recommend U.S. Food and Drug Administration approved cessation therapies and provide education on potential risks and benefits of ECs.²³ To date, there is no recommendation on EC use from the American Academy of Allergy, Asthma & Immunology or the American College of Allergy, Asthma & Immunology. Given the lack of consistent guidelines, physicians' views on ECs

as a cessation tool also vary greatly. The allergists, pulmonologists, and primary care physicians in this study all reported "very unlikely" or "somewhat unlikely" to recommend ECs as a cessation aid in this study.

Research on cigarette cessation counseling cites a lack of information about TC smoking cessation,²⁴ lack of confidence in counseling skills,²⁵ lack of support services,²⁶ and time constraints^{24,26} as reasons why physicians do not perform such highly effective counseling. Although being supportive and nonjudgmental can certainly help bring about behavior change, it is more difficult for physicians to do so with ECs because the above-mentioned reasons are likely magnified with regard to EC cessation counseling. Given the increasing risk of EC exposure to a variety of respiratory diseases, especially asthma, it is important for allergists to keep abreast of the most current information on ECs and discuss cessation with their patients.

Because this was a survey, it was subject to a number of limitations. First, it investigated a sample of physicians in only one area of the country, and it may not be possible to generalize these findings. Although it is encouraging that we were able to achieve a 46% response rate (typically higher than the other published studies that surveyed physicians), it is not possible to know if reports of use, knowledge, and practice of respondents differ from those of non-respondents. In addition, survey answers may be biased, given that it was based on self-reported data rather than actual practices. Of note, because this study was hypothesis generating, a power calculation was not performed.

CONCLUSION

We found that the physicians across specialties lacked knowledge and the skills to provide EC cessation counseling. Specifically, allergists rarely screened for EC use, knew very little about ECs, did not believe ECs were effective cessation tools nor did they feel comfortable at providing EC cessation counseling. The pulmonologists and primary care physicians performed better across these domains than did the allergists. As EC use becomes more prevalent and as allergists are a specialist of choice for patients with asthma, it is critical that they should become better educated and informed on this important public health topic.

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