

Online Patient–Provider E-cigarette Consultations

Perceptions of Safety and Harm

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Introduction: E-cigarettes are popular and unregulated. Patient–provider communications concerning e-cigarettes were characterized to identify patient concerns, provider advice and attitudes, and research needs.

Methods: An observational study of online patient–provider communications was conducted January 2011–June 2015 from a network providing free medical advice, and analyzed July 2014–May 2016. Patient and provider themes, and provider attitudes toward e-cigarettes (positive, negative, or neutral) were coded qualitatively. Provider attitudes were analyzed with cumulative logit modeling to account for clustering. Patient satisfaction with provider responses was expressed via a Thank function.

Results: An increase in e-cigarette–related questions was observed over time. Patient questions (N=512) primarily concerned specific side effects and harms (34%); general safety (27%); e-cigarettes as quit aids (19%); comparison of e-cigarette harms relative to combusted tobacco (18%); use with pre-existing medical conditions (18%); and nicotine-free e-cigarettes (14%). Half of provider responses discussed e-cigarettes as a harm reduction option (48%); 26% discussed them as quit aids. Overall, 47% of providers' responses represented a negative attitude toward e-cigarettes; 33% were neutral (contradictory or non-committal); and 20% were positive. Attitudes did not differ statistically by medical specialty; provider responses positive toward e-cigarettes received significantly more Thanks.

Conclusions: Examination of online patient–provider communications provides insight into consumer health experience with emerging alternative tobacco products. Patient concerns largely related to harms and safety, and patients preferred provider responses positively inclined toward e-cigarettes. Lacking conclusive evidence of e-cigarette safety or efficacy, healthcare providers encouraged smoking cessation and recommended first-line cessation treatment approaches.

(Am J Prev Med 2016;■(■):■■■–■■■) © 2016 American Journal of Preventive Medicine. Published by Elsevier Inc. All rights reserved.

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0749-3797/\$36.00

<http://dx.doi.org/10.1016/j.amepre.2016.06.018>

Introduction

Introduced to the market in 2007,¹ sales of electronic nicotine delivery systems (ENDS, e.g., e-cigarettes, vape pens) doubled in 2012–2013,² with >460 brands of e-cigarettes identified by 2014.³ The U.S. ENDS market is estimated to reach \$6 billion by 2019,⁴ and to overtake combustible cigarettes by 2023.⁵ ENDS use is primarily among smokers, though increasing among U.S. young never smokers. From 2013 to 2014, past month e-cigarette use among U.S. adolescents tripled and surpassed that of conventional cigarettes and climbed further in 2015.⁶

Questions have been raised about the health ramifications of e-cigarette use at the individual and population

levels. Likely less harmful than combustible cigarettes, unknown are the health consequences of repeated inhalation of propylene glycol, glycerin, and flavoring chemicals in e-cigarette liquid. Further, early brain exposure to nicotine via e-cigarettes among youth raises concerns about potential transitions to later tobacco smoking and use of other drugs with vaping devices.⁷

The extant scientific literature on e-cigarettes as cessation aids for combustibles is mixed. The two published RCTs found no advantage of nicotine-delivering versus placebo e-cigarettes^{8,9}; observational data, however, suggest that e-cigarettes are now the most common cessation tool used by smokers in the United Kingdom.¹⁰ The U.S. Preventive Services Task Force¹¹ and other leading health organizations^{12,13} have concluded in their guidelines for tobacco-cessation treatment that there is currently insufficient evidence to determine the relative help versus harm of ENDS for smoking cessation.

Despite the limited evidence, 38.5% of current smokers in one study believed the U.S. Food and Drug Administration had approved e-cigarettes for cessation, and 18% reported a provider had supported e-cigarettes as a cessation aid.¹⁴ Similarly, a 2013 survey of North Carolina physicians found that two thirds viewed e-cigarettes as helpful cessation aids, with more than a third recommending them to patients who smoke.¹⁵ A 2013 survey of Minnesota providers found 92% expressed interest in learning more about e-cigarettes; many reported obtaining information primarily from patients, news sources, and advertisements—rather than professional or scientific sources.¹⁶ Similarly, providers surveyed in Ohio identified the need for more research on e-cigarettes; many expressed low confidence for effectively addressing patients' questions about e-cigarettes, and their attitudes toward e-cigarettes as cessation aids were split between negative (31%); neutral (38%); and positive (21%).¹⁷

Research on patient-provider e-cigarette consultations to date has relied on retrospective reports of clinical practices. Providing a unique opportunity for observation, the current study analyzed data collected via an online medical advice forum. The study aimed to identify patients' pressing concerns regarding e-cigarettes and to characterize current provider advice and counseling trends.

Methods

Data Sample

Data were publicly available from HealthTap, an online patient-provider digital health service with a repository of anonymous patient questions and public answers from approximately 72,000 U.S.-licensed providers—doctors of medicine, mental health, and dentistry. Stanford University's IRB determined the study qualified for an exemption. A keyword algorithm in R, version 3.2.1, was developed to identify patient questions concerning e-cigarettes and

the corresponding provider responses. It was also used to identify provider answers referencing e-cigarettes in response to patients' tobacco-related questions. Coding and analyses were conducted from July 2014 to May 2016.

Data Coding

Questions and answers often addressed multiple topics; hence, they could be coded for more than one theme. The coding schema incorporated current literature topics (e.g., general safety, use by youth) and emergent themes (e.g., detection of use in drug testing) (Table 1, Figure 1, Appendix A). The research team iteratively developed and reviewed the coding schemas for the patient questions and provider answers. In addition, provider answers were coded ordinally as negative, neutral, or positive in attitude toward e-cigarettes. Random samples of 5% of the questions and answers were independently double coded by a study physician and a research associate after 4 hours of training ($\kappa > 0.81$). A third coder (PhD linguist) resolved conflicting codes, reviewed the entire question data set, and consulted on complex answers and attitude codes.

Statistical Analysis

All calculations were conducted in R using generalized estimating equations (GEE) to estimate population averages of interest. Patient questions were posted anonymously; responses were identified with a provider ID. Providers could answer more than one question. Wald CIs at 95% were calculated for provider answer attitudes via the robust variance estimator of ordLORgee (multgee package) specified with a cumulative logit proportional odds model.^{18,19} In cases with only two attitude levels, similar CIs were constructed with a logit model specified in geeglm.

To test whether provider answer attitude varied by medical specialty, provider answer attitude was regressed on medical specialty via ordLORgee, again specified with a cumulative logit proportional odds model. In all GEE analyses, an exchangeable working correlation structure was used to account for outcome clustering by provider.

In addition to posting questions and responses, HealthTap allows patients and providers to endorse provider answers. Patients can "thank" providers for responses to their or others' questions; as a metric, "Thanks" per answer may indicate patient satisfaction. Similarly, providers can publicly "agree" with other providers' responses; hence, "Agrees" constitute an informal peer review process, and the number of Agrees per answer may indicate building consensus or perceived answer validity. Analyses tested whether the number of Thanks and Agrees was associated with the coded attitude of providers' responses (i.e., positive, negative, or neutral toward e-cigarettes). This analysis was based on the assumption that the Thanks and Agrees were entered by distinct individuals. Poisson regression was run in geeglm with an exchangeable working correlation structure, which accounted for clustering by provider (i.e., the mean number of approvals may change depending on if a provider is liked or disliked).

Results

An automated search identified 9,723 tobacco-related questions posted from July 2011 through June 2015, of which 512 questions related to e-cigarettes (5.3% overall).

Table 1. Thematic Comparison of Online Patient Questions (n=512) and Provider Answers (n=623) Concerning E-cigarettes

	Themes	Patient questions, % (n)	Representative patient quote ^a	Provider answers, % (n)	Representative provider quote
1	Harm reduction relative to combusted tobacco	18 (93)	"From a health perspective, is an electronic cigarette better than traditional ones?"	48 (301)	"While we cannot say they are safe, we can say they are safer than smoking tobacco"
2	Specific side effects and harms	34 (173)	"Does nicotine/e-cigs cause hair loss? If so how can I prevent it while enjoying my e-cig?"	46 (287)	"[E-cigarettes] tend to irritate the lungs"
3	General safety	27 (137)	"Are e-cigs unsafe and can they become addictive?"	34 (212)	"E-cigarettes? Yes, they are not healthy."
4	Use as a quit-aid	19 (98)	"I quit smoking 7 days ago. I am using a vapor cigarette. I am doing very well. This was recommended to me. Your views on this?"	26 (164)	"E-cigarettes can be a good stepping stone toward quitting smoking..."
5	Other chemicals such as in flavors (does not include nicotine)	7 (38)	"What type of propylene glycol can I get for my vape pen that's healthy to consume?"	24 (151)	"[E-cigarettes] have propylene glycol, formaldehyde, flavorings, additives, etc. that have unknown safety or dangers..."
6	Use with pre-existing medical conditions	18 (91)	"Can vapor cigarettes affect asthma?"	23 (144)	"Vaping after a tooth extraction is not recommended for one week, because vapor can reduce saliva that promotes healing."
7	Research evidence	0	n/a	20 (127)	"There urgently needs to be more studies on this"
8	Nicotine health risks	5 (26)	"What are the side effects of nicotine by itself? As in using vapors, the only thing in it is nicotine."	18 (114)	"it [nicotine]...is partly responsible for...heart disease"
9	Addiction	0.8 (4)	"I can't stop smoking my e-cigarette. Is this a bad addiction?"	14 (89)	"With the right treatment you can break the addiction."
10	Nicotine-free e-cigarettes	14 (73)	"Lots of my friends smoke hookah pens. You can get them at the gas station and they say no nicotine/tobacco/tar etc. Are they harmless?"	12 (74)	"Don't know—I think the jury is still out on the safety of these products [non-nicotine e-cigarettes]."
11	Regulation	2 (8)	"Should electronic cigarettes be banned in public places?"	7 (44)	"E-cigarettes are not regulated by the FDA (Food and Drug Administration)."
12	Child or adolescent use	6 (32)	"I am 16 years old and I smoke hookah/vape occasionally, if I'm on loestrin can I still smoke or just not as often?"	6 (37)	[Responding to 17-year-old]"Just say no now! Please!"
13	Use among non-smokers	3 (13)	"...are electric cigarettes bad for you if you are a non smoker?"	5 (34)	"The associations [between e-cigarettes and] cigarettes and nicotine are generally what really re-addicts quitters."
14	Detection of use via drug testing	5 (23)	"I am going to take a blood test soon and I was wondering since I smoke hookah pens without nicotine, will it show up?"	5 (29)	"They are testing for breakdown products of nicotine so e-cigarettes with nicotine will be detected."
15	Secondhand vapor exposure	3 (13)	"Is electronic cigarettes safe to smoke around children?"	4 (28)	"At the very least consider the courtesy of inflicting your vapors on others."

^aSpelling and grammatical errors corrected for readability.

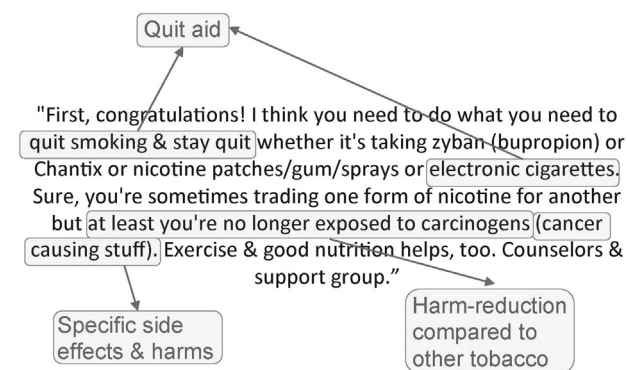


Figure 1. Thematic coding: provider answer example.

The ratio of e-cigarette to tobacco-related questions changed over time. E-cigarette questions were 1.2% of tobacco-related questions in fiscal year 2011 ($n=14/1,154$ between July 1, 2011, and June 31, 2012) and increased to 7.9% of tobacco-related questions by fiscal year 2015 ($n=139/1,753$).

The 512 questions from patients related to specific side effects and harms (34%; e.g., numb tongue, twitching in ear, cancer, chest pain); general e-cigarette safety (27%); use as a quit aid (19%); harm reduction compared to combusted tobacco (18%); use with pre-existing medical conditions (18%); and nicotine-free e-cigarettes (14%) (Table 1). Additional themes that occurred <10% of the time were chemicals other than nicotine (e.g., flavorings); use by youth; nicotine health risks; detection via drug testing; use among nonsmokers; secondhand vapor; regulatory issues; and addiction.

The provider answer set included all responses to the 512 patient e-cigarette questions ($n_{\text{answers}}=630$), plus 118 additional answers where providers introduced e-cigarettes in response to a tobacco-related question that did not reference e-cigarettes ($N_{\text{answers}}=748$ total responses). The number of providers responding was 368. Provider answers were on average longer and covered more topics than patient questions (average words per provider answer, 22.17; average words per patient question, 16.32). Providers could answer more than one patient question; however, in the current data set, most providers were represented a single time (median, 1; interquartile range, 1, 2). Outlier providers ($n=2$), defined as those who responded to >25 questions, contributed 34 and 91 answers, and caused ordLORgee to fail owing to a prohibitively large covariance matrix. The resulting sample of 366 providers represented 12 specialties/domains (Table 2).

Among the 623 answers from the 366 included providers, the most frequent themes matched that of patients' questions: harm-reduction relative to other

tobacco (e.g., combustible cigarettes, 48%); specific side effects and harms (46%); and general safety (34%). Other prevalent provider themes were e-cigarettes as quit aids (26%); chemicals other than nicotine (24%); e-cigarette use in the presence of medical conditions (23%); the extent of research evidence (20%); nicotine health risks (18%); addiction (14%); and nicotine-free e-cigarettes (12%). Provider answer themes that occurred in <10% of the sample were regulation, use by youth, use by nonsmokers, detection by drug tests, and secondhand exposure (Table 1). Additional topics of interest either occurred within reported themes or very infrequently: tar and resin in harm reduction ($n=28$); e-cigarette nicotine dose/tapering in quit aids ($n=27$); and dual use of e-cigarettes with other tobacco products ($n=4$; patient questions, $n=14$).

Comparing the coded themes of patient answers and provider responses, topics mentioned in similar proportion included nicotine-free e-cigarettes, drug tests, use by youth, secondhand vapor, and use by nonsmokers. Topics much more frequent in responses than questions concerned harm reduction relative to combusted tobacco (48% of responses vs 18% of questions); other chemicals/flavors (24% vs 7%); research needs (20% vs 0%); nicotine health risks (18% vs 5%); and addiction potential (14% vs 0.8%).

When patients asked about quitting conventional cigarettes ($n=97$ questions), in all but two instances (98%) providers responded with encouragement to quit smoking. Providers also included cessation advice in their responses to questions that did not ask about quitting. Among the 168 providers who advised quitting

Table 2. Specialty for HealthTap Providers in Sample

Specialty	<i>n</i> (% of sample)
Anesthesiology	7 (2)
Dentistry	29 (8)
Emergency Medicine	12 (3)
Internal Medicine	103 (28)
Obstetrics and Gynecology	10 (3)
Ophthalmology	9 (2)
Pediatrics	29 (8)
Primary Care	66 (18)
Psychiatry	23 (6)
Psychology (Clinical)	7 (2)
Surgery	33 (9)
Other	38 (10)
Total	366 (100)

smoking, 31% suggested quitting cold turkey or did not identify a formal cessation method ($n=52$); 15% recommended first-line cessation medication, counseling support, or both in combination, and did not include e-cigarettes ($n=26$); and 54% included e-cigarettes as cessation aids, with or without reference to other cessation treatments ($n=90$). Some provider answers concerning e-cigarettes as a cessation aid recommended specific doses ($n=7$) or tapering ($n=13$).

Figure 2 summarizes provider answer attitudes for high-frequency themes; error bars represent clustering-adjusted 95% CIs. Overall, the estimated mean frequencies for provider attitudes were 47% negative (95% CI=40%, 54%) and 20% positive (95% CI=15%, 26%). Provider attitude did not differ by specialty ($p=0.35$). All responses mentioning addiction risk ($n=89$) and use by youth ($n=37$) were coded as negative, whereas all responses concerning harm reduction compared with combusted tobacco ($n=301$) were coded as positive or neutral in attitude toward e-cigarettes. Most responses about use of e-cigarettes for quitting combustible cigarettes also were positively coded (121 of 163, 74%). Provider attitudes were neutral or balanced for themes related to other chemicals/flavorings, nicotine-free e-cigarettes, secondhand vapor, and detection via drug testing. All responses were negative or neutral for

responses concerning use by nonsmokers ($n=34$). Half or more of the responses were coded as negative in attitude toward e-cigarettes for the remaining answer themes of side effects and harms, general safety, nicotine health risk, use in the presence of medications or pre-existing conditions, extent of research evidence, nicotine health risks, and level of product regulation (data not shown for themes occurring in <10% of responses).

Thank counts were available for 365 providers and their 621 answers, which averaged 0.9 Thanks. Half of provider responses received at least one Thank (48%), and those that did averaged 1.88 Thanks. Themes averaging at least one Thank per answer concerned e-cigarettes as quit aids (1.71) and harm-reduction relative to combusted tobacco (1.15).

The regression-estimated mean number of patient Thanks for neutral attitudes did not significantly differ from that of negative attitudes, whereas the estimated means for positive and negative attitudes were significantly different. Hence, a reduced model was subsequently fit with negative and neutral attitudes grouped together. The estimate for neutral/negative attitudes was 0.74 (95% CI=0.63, 0.88) Thanks per answer. The corresponding ratio of the estimated mean number of Thanks for positive attitudes to the estimate for negative/neutral attitudes was 2.35 (95% CI=1.47, 3.76). That is, the ratio of estimates was significantly greater than 1, indicating that answers where providers expressed positive attitudes toward e-cigarettes may have been more highly approved by patients than responses coded as negative or neutral ($p < 0.001$).

Most providers (363 of 366, 99%) received at least one Agree to their answers, with an average of 0.91 Agrees per answer. Among the 49% of answers that received at least one Agree, they averaged 1.85 Agrees per answer. The answer themes averaging at least one Agree related to secondhand vapor exposure (1.61); e-cigarettes as quit aids (1.15); and nicotine health risks (1.04). The regression-estimated mean number of Agrees did not significantly differ by attitude ($p=0.27$). A reduced intercept-only model was therefore subsequently fit, and the corresponding estimated mean number of Agrees was 0.93 (95% CI=0.82, 1.05). This difference from the empirical average of 0.91 may indicate that clustering was present (e.g., some providers may have received more (or less) Agrees than others in general).

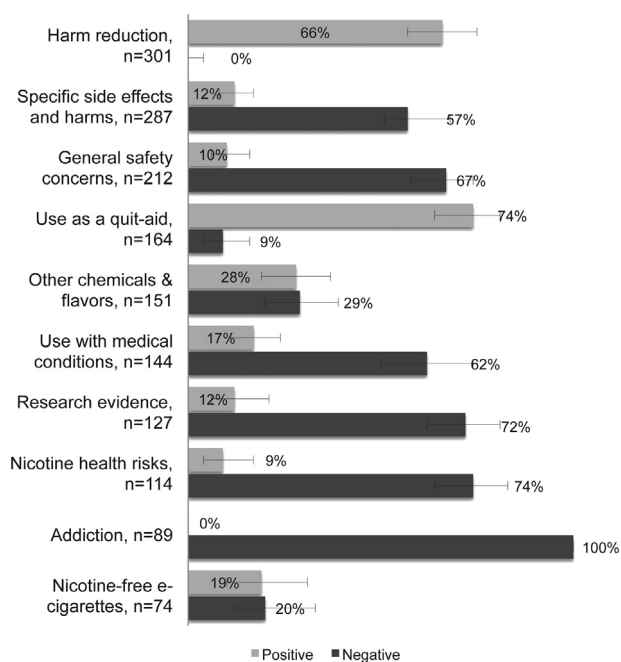


Figure 2. Provider attitude toward e-cigarettes by theme. Notes: Error bars are larger with a smaller number of provider responses. Themes are ordered from most frequent (top) to least frequent (bottom) on y-axis. Neutral attitudes were assessed but are not shown. Figure contains only themes representing 10% or more of provider responses.

Discussion

In a database of online patient-provider consultations from a publicly available digital health service, keyword searches identified nearly 10,000 patient questions related

to tobacco use, highlighting the importance of this topic in public health. The providers were mostly physicians, representing a range of specialties. E-cigarette questions, though a minority of tobacco questions, increased over time from July 2011 to June 2015. Patients' questions and providers' responses largely related to general safety and specific side effects and harms of using e-cigarettes and their potential as a form of harm reduction relative to other tobacco (e.g., combustible cigarettes). Providers discussed some themes more than patients (nicotine risks, other chemicals and flavors, addiction, research evidence), whereas topics related to e-cigarettes as quit aids and regarding use in the presence of medical conditions were discussed in similar proportions.

Prior survey studies with clinicians reported generally more positive attitudes toward e-cigarettes than observed in these online patient-provider exchanges.^{15,16,20,21} Here, only 20% were positive in tone, whereas 46% expressed negative attitudes toward e-cigarettes. Patterns were found with certain themes coded more negatively (side effects and harms, nicotine health risk, general safety, use with pre-existing conditions, research, regulation, addiction, and use by nonsmokers and youth), others more positively (harm reduction compared with combusted tobacco, use as quit aids), and some largely neutral (other chemicals/flavors, nicotine-free e-cigarettes, secondhand vapor, and drug testing). Provider responses noting the need for research and regulation were consistent with recent survey findings from providers in Ohio.¹⁷ National surveys report that past month e-cigarette use is most common among current smokers (21%) relative to former (4%) and never (1%) smokers.²² Notably, in the observed patient-provider consultations, the authors saw little indication of "dual use." Instead, the analysis of patient satisfaction (Thanks) and provider endorsement (Agrees) indicated interest in e-cigarettes as quit aids. This distinction may reflect differences between intended use (among inquiring patients) and actual use (from national surveys).

In the analysis of patient satisfaction (Thanks) and provider endorsement (Agrees), both providers and patients appeared interested in e-cigarettes as quit aids. Further, provider responses coded as positive in attitude toward e-cigarettes were more likely to be thanked by patients, possibly reflecting patient cognitive bias toward advice to use e-cigarettes. Motivational interviewing is recommended as an evidence-based approach for engaging smokers in cessation treatment.²³ When advising patients on e-cigarette use, adopting a motivational interviewing style that is reflective and patient-focused may similarly help to reduce resistance and enhance rapport.

Limitations

Though a novel query and summary of online patient-provider e-cigarette communications, the current study has limitations. The patients' questions were posted anonymously, which limited understanding of the data origins. Further, it was not possible to determine whether some individuals posted multiple times. The providers were identified and their responses were posted publicly, which may have constrained their answers. Purely observational, this study did not assess patient e-cigarette experience or information sources guiding provider opinions. The HealthTap features for Thanks and Agrees could be influenced by factors other than content, such as patient gratitude or how long an answer was on the site. Although this study's exploratory findings generally cannot provide strong inferential evidence, the findings do illustrate a well-reasoned set of plausible estimates and inferences to inform future hypotheses. Physician adoption of social media is reported to be invariant by age or gender,²⁴ and with respect to generalizability, HealthTap informally reports that the average demographics of their providers generally reflects that of U.S. physicians.²⁵

Conclusions

Physicians and other clinical providers are a critical source of health advice. Extending beyond the clinic walls, social media applications are increasing accessibility and, uniquely, enabling public observation of patient-provider communications. The questions observed here provide insight into patient viewpoints and concerns within the emerging alternative tobacco products landscape, with a focus largely on safety. Patients asked providers about a wide variety of e-cigarette topics, including use as a quit aid and use of nicotine-free e-cigarettes. Though provider responses varied in communication of risks and benefits, the sample expressed attitudes toward e-cigarettes that may generally be considered negative. They cautioned specifically against the addictiveness and physiologic effects of nicotine itself; the lack of research evidence and regulation; unknown and untested chemical additives (especially flavorings); and the potential risks of use and exposure among youth. The areas in which providers were generally positive focused on e-cigarettes as quit aids for tobacco and reduced harm as an alternative to combusted tobacco.

For informing the research agenda, the current findings point to key areas of interest, namely e-cigarette safety, side effects and harms, efficacy/effectiveness for cessation, nicotine health concerns, the impact of e-cigarettes on future generations, and the potential for e-cigarette addiction as a result of rapid arterial nicotine

absorption.²⁶ The variance in provider responses to patient questions highlights the need for ongoing medical education on the topic of e-cigarettes. Extending from the patient-provider consultations observed here, the Stanford Center for Continuing Medical Education has sponsored an open online course on e-cigarettes, available starting autumn 2016 at med.stanford.edu/cme/learning-opportunities/online.html.

Patients are seeking information on e-cigarettes. Questions from patients who smoke tobacco provide an opportunity for recommending evidence-based first-line cessation medications with psychosocial support as the standard of care. Providers have an opportunity to share what is known about e-cigarettes (e.g., less tar than cigarettes, not approved for smoking cessation, some chemical flavorings are toxic), as well as what remains currently unknown (e.g., efficacy and safety of emerging devices, long-term risks). Frank patient-provider conversations about the limitations of knowledge on e-cigarettes coupled with provider commitment to patient smoking cessation can establish trust while researchers and practitioners work to determine whether e-cigarettes should be considered as an alternative to combustible cigarettes, in what situations, and with what caveats.

The manuscript content is solely the responsibility of the authors and does not necessarily represent the official views of study funders or HealthTap, which supplied the data. HealthTap had no role in the study design or the decision to submit the report for publication.

This work was supported by the National Heart, Lung, and Blood Institute Grants R01HL117736 and T32 HL007034; National Cancer Institute Grant R25 CA-113710; and the State of California Tobacco-Related Disease Research Program, Grant 21BT-0018.

AB, JP, and CB-J conceptualized and conducted the study. AB and CB-J contributed to data definition. GR facilitated data collection. CB-J, AB, and GR had full access to all of the data in the study and take responsibility for the integrity of the data as guarantors. AB, JP, CB-J, AW, and AC contributed to the development of the coding instruments and coded data. AB, JP, CB-J, ED analyzed and interpreted results. CB-J led the writing of the article with significant contributions from AB and JP, while all authors reviewed, revised, and approved the final article.

AB and AW were previously employed by HealthTap. GWR is Chief Medical Officer and Co-Founder of HealthTap. JP has received consulting fees from Pfizer, which makes smoking-cessation medications, and has been a paid expert in court cases against the tobacco companies. No other financial disclosures were reported by the authors of this paper.

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Appendix

Supplementary data

Supplementary data associated with this article can be found at <http://dx.doi.org/10.1016/j.amepre.2016.06.018>.