

Original Investigation

Interviews With “Vapers”: Implications for Future Research With Electronic Cigarettes

Amy McQueen, Ph.D.,¹ Stephanie Tower, B.A.,¹ & Walton Sumner, M.D.²

¹ Division of Health Behavior Research, Department of Medicine, School of Medicine, Washington University, St. Louis, MO

² Division of General Medical Sciences, Department of Medicine, School of Medicine, Washington University, St. Louis, MO

Corresponding Author: Amy McQueen, Ph.D., Division of Health Behavior Research, School of Medicine, Washington University, 4444 Forest Park Ave., St. Louis, MO 63108, USA. Telephone: 314-286-2016; Fax: 314-286-1919; E-mail: amcqueen@dom.wustl.edu

Received January 6, 2011; accepted April 5, 2011

Abstract

Introduction: Awareness and use of electronic cigarettes (e-cigs) has increased dramatically. Electronic Nicotine Delivery Devices deliver an aerosol comprised usually of water, propylene glycol and/or glycerin, nicotine, and flavorings. Scant research exists to evaluate the efficacy and safety of such devices, and only one quantitative survey of European users ($N = 81$) has been published. This qualitative study explores e-cig users’ (“vapers”) experiences.

Methods: Participants attended a convention or club meeting in St. Louis, MO, and were interviewed individually or in small groups. Qualitative methods were used to analyze interview data for both deductive and emergent themes to broad research questions.

Results: Even with a relatively small sample of formal participants ($N = 15$), there were pervasive themes including the language and culture of vaping; social and informational support among vapers and their use of Internet resources (learning about e-cigs); the learning curve to using e-cigs and the numerous modifications (“mods”) available for e-cigs and personal vaporizers; motives and perceived benefits of using e-cigs versus cigarettes including cigarette-like enjoyment, cost, restored sense of taste and smell, and improved breathing and exercise tolerance; rapidly reduced nicotine tolerance and dependence; and a strong interest in e-cig-related research and policy.

Conclusions: The learning curve to using e-cigs has important implications for laboratory tests of these devices with novice users. Similarly, the multiple e-cig options and the use of “mods” create challenges for researchers and policy makers. Transdisciplinary research is urgently needed, and experienced “vapers” are very interested and willing research participants.

Introduction

Electronic cigarettes (e-cigs) are novel Electronic Nicotine Delivery Devices (ENDD) embraced by some users as a life-saving

innovation but viewed with skepticism by many public health professionals (Cobb, Byron, Abrams, & Shields, 2010; Henningfield & Zaatari, 2010; Pauly, Li, & Barry, 2007). Worldwide awareness and use of e-cigs has increased dramatically since 2004 when e-cigs were introduced in China (World Health Organization, 2008).

E-cigs comprise a battery, automatic or manual switch, heating element, and reservoir of liquid nicotine solution. The solution—also called “juice,” “liquid,” or “e-liquid”—usually contains water, propylene glycol and/or vegetable glycerin, nicotine, and flavorings. When the user draws air through the mouthpiece, the heating element (“atomizer”) vaporizes the nicotine solution. The vapor condenses to an aerosol that the user inhales and exhales like cigarette smoke. E-cigs mimic the appearance and ergonomics of cigarettes, which may appeal to some smokers (Rose, Behm, & Levin, 1993).

Although “smoking causes diseases in nearly every organ of the body” (Surgeon General’s Report, 2004), nicotine inhalation without smoke should be less risky for smokers and bystanders (McNeil, Foulds, & Bates, 2001; Sumner, 2005). Nevertheless, there is scant research supporting e-cigs, quality control varies, and some nations have banned e-cigs (Ang, 2009; Kesmodel & Yadron, 2010). Although nicotine accounts for very few of the long-term hazards of smoking, it may contribute to destruction of connective tissue (McAllister-Sistilli et al., 1998), modulation of immune function (Onoda et al., 2001), prevention of apoptosis (Henningfield, Clayton, & Pollin, 1990; Wright, Zhong, Zheng, & Larrick, 1993), and alcohol or other substance abuse (Hipke, 1993; Madden, Heath, Starmer, Whitfield, & Martin, 1995; Narahashi et al., 2001). Research suggests that smokeless tobacco users experience only about 2% of the risks of smoking (Vigneswaran, Tilashalski, Rodu, & Cole, 1995) and that inhaled nicotine is similarly benign in animal models (Hilts, 1996; Loennechen et al., 2002; Syversen et al., 1999); thus, it is unlikely that the harms of inhaled nicotine would compare with the harms of smoking (Sumner, 2005). In addition to nicotine, e-cig users would be exposed to any hazardous chemicals in the nicotine solution or created during use. For example, the U.S. Food and Drug Administration

doi: 10.1093/ntr/ntr088

© The Author 2011. Published by Oxford University Press on behalf of the Society for Research on Nicotine and Tobacco. All rights reserved. For permissions, please e-mail: journals.permissions@oup.com

(FDA) found trace levels of harmful chemicals and inaccurate labeling of nicotine content in some e-cig cartridges (FDA, 2009b).

Scant published research on e-cigs is available, but significant variability in nicotine delivery has been reported. A smoking machine study found nonuniform dosing of nicotine within and across e-cigs (Trtchounian, Williams, & Talbot, 2010). In other studies exposing smokers to e-cigs, low serum nicotine levels were observed (Eissenberg, 2010; Vansickel, Cobb, Weaver, & Eissenberg, 2010). Although smokers preferred smoking their own cigarette brand, smokers reported some benefits after their first use of an e-cig compared with an unlit cigarette despite low nicotine delivery from the e-cig (Vansickel et al., 2010). Few differences in desire to smoke or withdrawal symptoms were reported by smokers assigned to e-cigs with either 0 or 16 mg/ml nicotine or a standard nicotine inhaler; nevertheless, participants preferred the 16 mg/ml e-cig for pleasantness of use and as a cessation aid (Bullen et al., 2010).

The only published study of ENDD users involved 81 respondents to a French-language Internet survey (Etter, 2010). Most were former smokers who began using e-cigs within the past three months, strongly believed that e-cigs helped them quit smoking, and chose to use e-cigs because they perceived less health risks, cost, and prohibitions compared with cigarettes. Respondents enjoyed “vaping” (inhaling the vapor) and reported improved breathing, less coughing, no unpleasant odor, and only minor negative effects (e.g., dry mouth and throat). Some respondents reported quality problems and worried about the lack of research on e-cigs’ safety. An English-language survey of ENDD users ($n = 303$) found similar results (Heavner, Dunworth, Bergen, Nissen, & Phillips, 2009). Most respondents were former smokers who had started using e-cigs within the past six months to replace cigarettes after failing conventional smoking cessation treatments. E-cig users who reported health improvements were more likely to be younger and to have used e-cigs longer and exclusively.

The purpose of this exploratory qualitative study was to better understand e-cigs as well as the personal experiences and motivations of e-cig users. Such understanding will inform future research including clinical trials of ENDD as smoking cessation aids.

Methods

Participants and Procedures

Although all participants were knowledgeable early adopters of e-cigs, we did not systematically recruit experts, leaders, or stakeholders (“key informants”) to report on e-cig users in general (Schensul, 2008). We interviewed a convenience sample of participants from the MidWest Vapefest in St. Louis, MO, in August 2010 ($N = 180$ attendees) and from subsequent meetings of the MidWest Vapers Group based in St. Louis, MO ($N = 30$ members). The convention brought e-cig users (“vapers”) and vendors together from multiple states. Similar conventions are held frequently across the United States. At the convention, loudspeaker announcements alerted attendees of their opportunity to be interviewed. We could not accommodate everyone interested in being interviewed in the time we allotted for data collection during the convention and not all conversations were

treated as formal interviews. For example, we informally talked with the 16 vendors and sponsors individually, at least briefly. Thus, our total interactions (formal and informal) with vapers informed our findings. We interviewed and obtained written informed consent from 15 individuals and audio-recorded interviews with 13 of those people; 2 of the 15 had financial interests in the sale of e-cigs or e-liquid. Most participants were interviewed in pairs in semiprivate lounge areas outside the convention ballroom. Five of the 13 audiotaped interviews were conducted at meetings of the MidWest Vapers Group following a similar procedure. The third author led all interviews. Interview length ranged from 39 to 79 min. Participants received no incentives or reimbursements. This research was approved by the Human Research Protection Office at Washington University in St. Louis.

We identified broad research questions of interest a priori based on the scant literature and comments in Internet forums and petitions: “How do users first learn about e-cigs?”, “How do users describe the experience of switching from cigarettes to e-cigs?”, “Do users trust the products?”, and “What problems have users had with devices?”

Analysis

The primary focus of our investigation was the pragmatics of e-cig use rather than the motives, emotions, and psychology of vaping; thus, our analytic approach was similarly pragmatic and focused on describing users’ experiences rather than on developing a theory that explained their behavior. Our general approach to analysis was similar to grounded theory qualitative methods (Charmaz, 2005; Glaser, 2002) in that the findings were “grounded” in the data and were developed inductively and in constant interaction with the data (Maxwell, 2005). Although we identified broad research questions a priori, we did not develop theories, conceptual models, or hypotheses a priori that were then tested against the empirical data. Bernard (2002) suggests that the heart of grounded theory is identifying themes and coding the presence and absence of those themes. However, in contrast to previous approaches used by the first author (McQueen et al., 2009) and common to qualitative research, we did not code transcripts (text) of the interviews using computer software. Instead, we used an iterative process of listening to the audio-recordings multiple times and making notes about the topics discussed and themes that emerged to identify the core themes for further analysis. Then, selected segments of the interviews that addressed these themes were transcribed verbatim and considered for direct quotation. Results were discussed among investigators, providing opportunities to challenge perceptions, explore potential negative and deviant cases, and reduce the potential for confirmatory bias (Esterberg, 2002; Pidgeon & Henwood, 1997). Core themes were identified from the interviews with convention participants and were further elaborated and verified with the subsequent interviews with local vapers group members. Additional interviews were not sought once the data became saturated, and no new themes became evident, and no contradictory evidence was reported. Written findings were shared with two interviewees to verify accuracy of descriptions of e-cig use and participants’ opinions and experiences (i.e., member checking; Lincoln & Guba, 1985). Those interviewees were selected from the total group of participants for their expertise and role as a resource for other vapers; one contributed to Internet forums and one organized a local vapers group.

Results

Convention attendees were diverse in age (i.e., 20s to 60s), gender, and occupation (e.g., skilled labor, lab technician, computer programmer, artist, marketing, lawyer, professor, electronics research and development, security guard), although predominantly White. Because of the recent introduction of e-cigs to the U.S. market, most attendees we queried had started using e-cigs in the past year and users-turned vendors had started small businesses within the past six months. The unique language shared among vapers was an overarching theme that we felt was important to understanding and appreciating the ENDD subculture, but it was not presented as an independent theme because it was inextricably linked to the content themes. The themes were loosely organized as a chronological experience of an e-cig user who becomes aware of e-cigs, finds a satisfying ENDD, successfully switches from smoking to exclusive vaping (overcomes the learning curve), and experiences specific benefits and the desire to share and safeguard those benefits. We provide identification numbers when specific participants are quoted or discussed but emphasize that these quotes most succinctly or cogently illustrated or embellished themes that were very broadly endorsed. Thus, our selection of quotes was not based on a concern for equal representation across participants.

Theme: Learning About E-Cigs

Users learned about e-cigs from various sources including friends, advertisements, and Internet sites. One vaper can have an important influence on other smokers. For example, two vapers reported distinct but similar work-site stories from the different perspectives of employee and supervisor. In each case, an employee introduced smoking coworkers to vaping. Conversion was facilitated when the supervisor converted to vaping and endorsed vaping in the workplace to improve indoor air quality or reduce unproductive breaks. Some early adopters became entrepreneurs and retailers, and some became unpaid “evangelists” who encourage smokers to try vaping and serve as a personal resource for new vapers. Some built Internet sites and forums dedicated to vaping where users can find e-cig products for sale, reviews of products and retailers, and tips on making, modifying, cleaning, and decorating e-cigs. Users and retailers laud Internet forums as invaluable for new users; “as a community, we come together and we help inform each other on what would be a good purchase and what would be quality” (ID# 1).

Theme: Learning Curve to Vaping

One of the most striking emergent themes was the vaping learning curve. E-cigs are more complex than cigarettes due to the different components and ease of use, especially for novices. Unlike combustible cigarettes, e-cigs comprise a few durable components with a myriad of replacement options. The devices require potentially time-consuming troubleshooting when one component fails. Components are not fully interchangeable: Mismatched components can block airflow. New users must learn to activate the atomizer to heat the liquid prior to vaping either through a manual switch or by taking “priming puffs” before inhaling. One participant (ID# 2) described an effective vaping technique as similar to smoking Swisher Sweets cigars: The user slowly draws aerosol into the mouth and inhales from there into the lungs—the slow inhalation may combine priming

and vaping puffs. Experienced vapers advise novice vapers to prepare for problems with e-cig components that cannot be replaced instantly. Additionally, the amount of liquid used daily is not easily predicted from daily cigarette consumption, so new users are advised to obtain extra liquid in advance. In contrast, cigarettes are ubiquitous, certain to work as expected, and pose a relapse temptation to frustrated new e-cig users who quit cigarettes. Some vapers identified the challenge of using and maintaining e-cigs as a significant barrier to converting smoking friends to vaping. Specific vocabulary used by experienced vapers illustrates the learning curve for using e-cigs and modified devices (Table 1).

Starter Versus Modified Devices

Vapers explained that they had wanted their first e-cig to look and feel like a cigarette. Similarly, new vapers generally use tobacco or menthol flavored nicotine solutions despite the large selection of flavors. Novice users often buy e-cig “starter kits” containing basic components, a battery charger, a few liquid refills, and instructions. Many experienced vapers described dissatisfaction with starter kits and sought a more satisfying device or combination of batteries, atomizers, and liquid. Some individuals buy or design their own modified devices or “mods,” which no longer resemble traditional cigarettes. Most mods include larger and/or higher voltage batteries. A larger battery lasts longer after recharging. A higher voltage battery vaporizes a larger amount of liquid, which produces a “throat hit” preferred by some users. Vapers’ individual style is evidenced by the numerous colors, artistic designs, carrying cases, and accessories for mods. Diverse mods and accessories create welcome options for users, retailers, and collectors but some confusion among novices.

The following quotes describe the vaping learning curve or barriers overcome by experienced users.

“Getting the right device and settling into that device and that liquid, that’s a learning curve and nobody’s the same.” (ID# 3)

“Finding the right device . . . there’s so many choices, the atomizer itself and the liquid; finding the flavor that works for you.” (ID# 3)

“I think it’s a matter of knowing when the battery is low and I probably need to get a new atomizer and knowing how much flavoring stuff to put in there and keeping that all in sync, plus technique.” (ID# 4)

“So there’s difference in manufacturers. Okay, so I have to be careful that I’m getting slotted material so that the airflow is right because if I get a no-slot battery and a no-slot cart, I’m dead in the water. And you know it took me a week or so to figure this out one time.” (ID# 5)

Theme: Motives and Perceived Benefits of Using E-Cigs

Most e-cig users were heavy smokers who hope that e-cigs will reduce their health risks. Many tried to quit with traditional pharmacologic cessation aids but described e-cigs as a vast improvement. One user said “as hard as it was to quit smoking, this provided people with enough of the other physical traits of

Table 1. Examples of the Vocabulary and Terminology Used by Experienced Vapers

Term	Explanation
E-cig	An electronic cigarette is a mechanical nicotine delivery device that includes a battery, automatic or manual switch, heating element, and reservoir of liquid nicotine solution.
Vaping	Behavior defined by inhaling the vaporized solution from an e-cig. Thus, a vaper is one who vapes.
E-liquid or juice	Liquid solution vaporized by e-cigs that generally consists of water, propylene glycol and/or vegetable glycerin, nicotine, and flavorings.
Atomizers (attys)	Heating element. The heat from the e-cig atomizer vaporizes the e-liquid. Expected to last weeks or months.
Cartomizers (carts)	Although some e-cigs contain a separate e-liquid cartridge and atomizer, a single cartomizer combines the two. Not expected to last as long as atomizers, but some users described cleaning and/or refilling cartomizers to extend their use.
Blanks	Refillable e-liquid cartridges.
Priming and switches	Users must learn how to activate the atomizer to heat the e-liquid. Some e-cigs have manual switches, whereas others have automatic switches that require low volume priming puffs prior to inhaling.
Dripping	Some users choose to drip extra e-liquid into the atomizer, and “drip tip” mouthpieces facilitate this practice. Experienced users note that dripping should only be done with manual switch e-cigs that have sealed batteries otherwise e-liquid may leak into the unsealed batteries of e-cigs with automatic switches.
PVs and mods	Personal vaporizers and modified e-cigs may not resemble cigarettes and instead resemble packs or large cylinders. Various colors and styles are available.
Volts	Most e-cig starter kits come with a 3.7 V battery (which ranges from 3.1 to 4.2 volts depending on charge strength), whereas mods may have a 5 or 6 V battery. Higher voltage batteries vaporize a larger amount of e-liquid.
Low-resistance atomizers	Combined with lower voltage batteries, these new atomizers produce effects comparable to standard atomizers with higher voltage batteries.
Pass throughs	Devices that provide continuous power to e-cigs through a USB connection to a computer.
Goose necks	An e-cig accessory that extends the mouthpiece with a flexible metal tube.

Note. USB = universal serial bus.

smoking to see it as a substitute or an alternative.” (ID# 1) Another said, “I can get the main things I want from smoking, plus without the negative health aspects of smoking.” (ID# 6)

Vaping was usually perceived to be less expensive than smoking (especially among those from states with higher tobacco taxes). One exception was a user who collected unique personal vaporizers and accessories: “if I didn’t collect them and I found one I was completely happy with and I stuck with that one, I would save money hand over fist on a daily basis.” (ID# 1) Another user reported “I originally thought that I might be able to actually even save some money, but that didn’t turn out to be the case because of the quantity that I personally consume.” (ID# 6)

One female participant was buying her first e-cig starter kit (after trying a friend’s e-cig) and was determined to quit smoking and vape exclusively to get her nicotine “fix” and maintain her desired weight. She described her decision to try e-cigs: “I finally found studies online that talked about metabolism and nicotine and all the rest of that and it verified what my sensibilities were telling me, which is that my system needs nicotine to operate at what to me is normal . . . I needed a way to get the nicotine without getting the tars and everything else and this is perfect.” (ID# 7) Another female participant had already quit smoking but recently started vaping with nonnicotine solutions to curb snacking and lose weight. She reported: “I want to do this just to lose weight. I have no desire to do any nicotine . . . What I intend to do is have this replace my snacking.” (ID# 4)

Similar to online surveys (Etter, 2010; Heavner et al., 2009) and petition comments (Care2, 2009), reported benefits of vaping (with reduced or no cigarette use) included an improved

sense of taste and smell, ability to be physically active, and less coughing and breathlessness. One user explained: “I don’t wake up coughing anymore . . . I can climb [stairs] without having to stop for breath half way up like I used to.” (ID# 1) Many experienced vapers, despite their own simulated smoking behavior, sounded like ex-smokers who detest the smell of smoke and avoid being around smokers. One user explained that she tried a cigarette after using e-cigs regularly and felt that “It was disgusting. It was so bad that I was washing my hands and I had to actually get a shower and change my clothes after having a cigarette outside. I just felt like I reeked of it.” (ID# 8) Immediate benefits were perceived to outweigh any potential long-term harms. One vaper indicated that using e-cigs “has improved my quality of life so much that whatever negative there is, I’ll deal with it when we discover it.” (ID# 5) Another user echoed this sentiment saying, “Even if this doesn’t add a second to my life, which I’m sure it won’t, the quality of our life is just immeasurably improved.” (ID# 8)

Theme: Reduced Nicotine Tolerance and Dependence

Many vapers reported using lower nicotine concentrations over time, and some planned to use nonnicotine liquids in the future. Some vapers described comfortably waiting long periods without vaping, which they could not do when smoking. For example, one vaper recalled feeling anxious and compelled to replace forgotten cigarettes when he was smoking but had no trouble working all morning when he accidentally left his e-cig at home (ID# 1). Another vaper revealed, “I don’t have the same sort of urgency about vaping that I had about smoking . . . I go all day without vaping and it doesn’t occur to me.” (ID# 9)

We had anticipated that deep inhalation may deliver nicotine rapidly in a highly addictive pattern comparable to a cigarette (Sumner, 2005). Others have described slow (if any) nicotine delivery in e-cig experiments with novice users accompanied by self-reported reductions in cravings comparable to nicotine inhalers or placebo (Bullen et al., 2010; Vansickel et al., 2010). In contrast, vapers' descriptions suggest an intermediate delivery speed. Vapers routinely described relief of nicotine craving within 5 min of vaping. Those who had tried the prescription inhaler found it unsatisfying (slower or lower nicotine delivery) and those who, after vaping exclusively for days or weeks, tried a cigarette described a dizzy rush "like the first time you smoked" (faster and higher nicotine delivery).

Additional quotes that illustrate vapers' reduced nicotine dependence include:

"I went from almost 3 packs [of cigarettes] a day to none within 3 days." (ID# 8)

"I've worked from 36 milligrams, which is pretty much the top of the line, down to 6 over the course of the year and a half and in a few months I'll lean towards zero." (ID# 3)

"I found that whenever I try to go down a level of nicotine, I'd use this thing [e-cig] a hell of a lot more for about a week or so. I just wasn't getting what I needed . . . then you start to slow down. It is that easy." (ID# 3)

Theme: Users' Interest in Research and Advocacy

E-cig users are vocal about potential bans as suggested by the 13,000 names and 8,000 comments in an online petition to the FDA to keep e-cigs legal (Care2, 2009). Our interviewees were supportive of research to assess the safety and efficacy of e-cigs, had read the scientific literature, and were willing to participate as subjects. The National Vapers Club (2010) is raising money to conduct a chemical analysis to learn what (if any) potentially harmful compounds are associated with ENDD aerosols.

Some users voiced disappointment and concern about devices and liquids from China because of inadequate information, product labeling, and customer support. These disappointments, the negative results of the FDA studies on Chinese products (FDA, 2009b), and users' pro-American sentiments supported U.S. entrepreneurs entering the market. In general, our participants reported only modest distrust for ENDD sold over the Internet, complained little about broken or incompatible components purchased online, and strongly valued the Internet forums for vetting products and vendors.

Vapers demonstrated enthusiasm for research and advocacy by citing studies they have read, eagerly offering to help with any future studies, encouraging other smokers to try vaping, and actively voicing their support of e-cigs to government authorities:

"You really need to look up the two New Zealand tests, both of them, because they have a lot of information in them . . ." (ID# 5)

"I am totally willing to participate in any further research and I will go to great lengths to assist you." (ID# 7)

"The reason that I still smoke this [traditional e-cig] I think I would prefer to go to one of the mods, but I don't, and the reason is I'm trying to encourage people to do this . . ." (ID# 5)

"We attended the [State] hearing regarding proposed legislation to ban the sale of e-cigarettes. We testified on behalf of [State] vapers . . . This was necessary since we were the ones with the legislative packets, studies, toxicology reports, experience, etc. to present to the committee." (ID# 9)

Discussion

Our interviews with e-cig users contribute new insights and understandings of e-cigs and the vaping community, which were not previously reported in the literature. The language of experienced users conveys a learning curve; it mixes technical, pseudo-technical ("cartomizer"), and popular ("juice") jargon. The challenges of vaping were overcome by intelligent determined users who formed an active community (both online and in person) to support new users.

The vaping learning curve, diverse device modifications, and numerous liquid options have important implications for future research. Specifically, our results suggest that it may be ineffective to ask new users to "smoke" an e-cig like they would their preferred brand of cigarettes (Bullen et al., 2010; Vansickel et al., 2010). Research is needed to describe the pharmacodynamics of vaping, how vaping changes with experience, and how vaping differs physiologically from smoking. Furthermore, a plethora of mods creates challenges for researchers and policy makers interested in user safety, the smoking cessation process, and the sociocultural aspects of the behavior.

Even if e-cigs are as safe as other smokeless nicotine products, the learning curve has important implications for future clinical and behavioral trials testing e-cigs as a smoking cessation aid. The rates of smokers using traditional nicotine replacement therapies (NRT) to quit smoking are low (22%–32%; Cokkinides, Ward, Jemal, & Thun, 2005; Shiffman, Brockwell, Pillitteri, & Gitchell, 2008), and it is unclear whether e-cigs would achieve higher cessation rates. Both e-cigs and traditional NRT involve complicated instructions and techniques for use as well as high upfront costs if not subsidized. Prices for popular e-cig starter kits are US\$50–80, which are comparable to the costs of over-the-counter NRT. Further price declines may make ENDD more accessible for lower income smokers; however, the intricacies of e-cig use and maintenance may hinder widespread adoption. However, unlike other NRT, ENDD might provide a more satisfying and comprehensive replacement for smoking (Bullen et al., 2010; Rose et al., 1993). The delivery of nicotine through NRT is slower and involves less dramatic peaks than cigarette smoking, and substantial individual variability in nicotine and cotinine levels has been reported across cigarette smoking, nicotine patch, and nicotine nasal spray (Benowitz, Zevin, & Jacob, 1997); thus, future research should compare e-cigs with both NRT and cigarette smoking.

Researchers and public health advocates have expressed concerns about e-cigs and caution against their use until

independent research is conducted (Abrams & Zeller, 2009; Henningfield & Zaatari, 2010; Pauly et al., 2007; Yamin, Bitton, & Bates, 2010). However, current e-cig users will not be deterred. Vapers endorsed e-cigs as “life-saving” and favored unknown e-cig risks over known cigarette smoking risks, despite concerns about long-term health risks and quality control for liquids and components. Evidence of the long-term health effects of vaping will not be available for many years, and results will be confounded by prior smoking. Studies testing the shorter term safety and efficacy of e-cigs are urgently needed. Vaping where cigarettes are banned may undermine clean air policies; research on e-cig aerosols is needed to address this concern. Another concern is that vaping will thwart smoker’s motivation to quit and simply replace cigarettes with another risky behavior. Research is needed on the efficacy of e-cigs as an NRT and the short- and longer term harms to health, especially if used as a permanent replacement for cigarettes. Future research should also address concerns about the attractiveness of e-cigs and flavored liquids among nonsmokers, ex-smokers, and adolescents (FDA, 2009a).

Limitations

We conducted only a small number of formal interviews. Nevertheless, themes became quickly saturated, confirmed on-line sources, and were repeated in informal conversations. Our participants were mostly experienced exclusive vapers, who were early adopters of unregulated, controversial products (i.e., e-cigs); therefore, results may not generalize to the whole population, including novice and former e-cig users. Our participants may differ from vapers who are not involved in Internet and/or in-person vaping communities. Future research could explore the experiences of smokers who tried e-cigs, were dissatisfied, and stopped vaping to better understand the factors that hinder conversion from smoking to vaping. Similarly, as ENDD advance, experiences of users may change over time. Our participants were not struggling financially, were adept Internet consumers, tended to be technology savvy, and clearly distinguished between the harms of nicotine versus smoke (harms that many smokers conflate; Bansal, Cummings, Hyland, & Giovino, 2004). Some users also benefited financially from the sale of e-cig liquids or devices. This may be the demographic for experienced e-cig users or reflects our convenience sample.

Conclusions

We did not have to interview many vapers to learn that vaping is not like smoking. Vapers follow a learning curve that involves selecting among numerous devices, components, liquids, and techniques. Additionally, vaping involves adapting to evolving products and maintenance issues and changing personal needs and preferences. The complexities of vaping have important implications for novice users, retailers, scientists, and policy makers. Experienced users report health gains typical for smoking cessation despite continued vaping and appear to be willing research participants. Independent research on the first- and second-hand health effects of e-cig aerosols is urgently needed to inform use and regulation of e-cigs as well as determine the utility of conducting further studies to assess the safety and efficacy of e-cigs as a smoking cessation aid. Additionally, research is needed to assess the effects on health if e-cigs are used long term. Future research will require transdisciplinary efforts,

which may be better informed by tapping the expertise of experienced vapers.

Funding

This research was conducted independent of grant funding. AM is supported by a Mentored Research Scientist Grant from the American Cancer Society (CPPB-113766).

Ethics Approval

This research was approved by the Human Research Protection Office at Washington University in St. Louis.

Declaration of Interests

None declared.

Acknowledgments

We gratefully acknowledge the support of the organizers and attendees at the MidWest Vapefest and members of the Mid-West Vapers Group. We also thank two of our interviewees for commenting on the final manuscript.

References

- Abrams, D., & Zeller, M. (2009, September). *Research strategies to inform FDA regulation of tobacco products*. Presented at the Schroeder Institute for Tobacco Research and Policy Studies meeting, Washington, DC.
- Ang, A. (2009). *Chinese e-cigs gain ground amid safety concerns*. Retrieved from <http://www.connectmidmissouri.com/news/story.aspx?list=194662&id=266622>
- Bansal, M. A., Cummings, M., Hyland, A., & Giovino, G. A. (2004). Stop-smoking medications: Who uses them, who misuses them, and who is misinformed about them? *Nicotine & Tobacco Research*, 6(Suppl. 3), S303–S310. doi:10.1080/14622200412331320707
- Benowitz, N. L., Zevin, S., & Jacob, P., 3rd (1997). Sources of variability in nicotine and cotinine levels with use of nicotine nasal spray, transdermal nicotine, and cigarette smoking. *British Journal of Clinical Pharmacology*, 43, 259–267. doi:10.1111/j.1365-2125.1997.00566.x
- Bernard, H. R. (2002). *Research methods in anthropology*. Walnut Creek, CA: AltaMira Press.
- Bullen, C., McRobbie, H., Thornley, S., Glover, M., Lin, R., & Laugesen, M. (2010). Effect of an electronic nicotine delivery device (e cigarette) on desire to smoke and withdrawal, user preferences and nicotine delivery: Randomised cross-over trial. *Tobacco Control*, 19, 98–103. doi:10.1136/tc.2009.031567
- Care2 (2009). *Keep life saving electronic cigarettes available!* Retrieved from <http://www.thepetitionsite.com/1/keep-life-saving-electronic-cigarettes-available/>

- Charmaz, K. (2005). Grounded theory in the 21st century: Applications for advancing social justice studies. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage handbook of qualitative research* (3rd ed., pp. 507–535). Thousand Oaks, CA: Sage.
- Cobb, N. K., Byron, M. J., Abrams, D. B., & Shields, P. G. (2010). Novel nicotine delivery systems and public health: The rise of the “E-Cigarette”. *American Journal of Public Health, 100*, 2340–2342. doi:10.2105/AJPH.2010.199281
- Cokkinides, V., Ward, E., Jemal, A., & Thun, M. J. (2005). Underuse of smoking-cessation treatments: Results from the National Health Interview Survey, 2000. *American Journal of Preventive Medicine, 28*, 119–122. doi:10.1016/j.amepre.2004.09.007
- Eissenberg, T. (2010). Electronic nicotine delivery devices: Ineffective nicotine delivery and craving suppression after acute administration. *Tobacco Control, 19*, 87–88. doi:10.1136/tc.2009.033498
- Esterberg, K. G. (2002). *Qualitative research methods in social research*. Boston, MA: McGraw-Hill.
- Etter, J. F. (2010). Electronic cigarettes: A survey of users. *BMC Public Health, 10*, 231. doi:10.1186/1471-2458-10-231
- FDA (2009a). *Candy and fruit flavored cigarettes now illegal in United States; step is first under new tobacco law*. Retrieved from <http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm183211.htm>
- FDA (2009b). *FDA and public health experts warn about electronic cigarettes*. Retrieved from <http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm173222.htm>
- Glaser, B. G. (2002). Conceptualization: On theory and theorizing using grounded theory. *International Journal of Qualitative Methods, 1*, 23–38.
- Heavner, K., Dunworth, J., Bergen, P., Nissen, C., & Phillips, C. V. (2009). *Electronic cigarettes (e-cigarettes) as potential tobacco harm reduction products: Results of an online survey of e-cig users*. Retrieved from <http://www.tobaccoharmreduction.org/wpapers/011.htm>
- Henningfield, J. E., Clayton, R., & Pollin, W. (1990). Involvement of tobacco in alcoholism and illicit drug use. *British Journal of Addiction, 85*, 279–291. doi:10.1111/j.1360-0443.1990.tb03084.x
- Henningfield, J. E., & Zaatari, G. S. (2010). Electronic nicotine delivery systems: Emerging science foundation for policy. *Tobacco Control, 19*, 89–90. doi:10.1136/tc.2009.035279
- Hilts, P. J. (1996). *Smokescreen: The truth behind the tobacco industry cover-up*. Reading, MA: Addison-Wesley Publishing Company.
- Hipke, M. E. (1993). Green tobacco sickness. *Southern Medical Journal, 86*, 989–992.
- Kesmodel, D., & Yadron, D. (2010, August 25). E-cigarettes spark new smoking war. *Wall Street Journal*. Retrieved from http://online.wsj.com/article/SB10001424052748704557704575437710870116450.html?mod=WSJ_hps_MIDDLESecondNews
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA: Sage.
- Loennechen, J. P., Nilsen, O. G., Arbo, I., Aadahl, P., Nilsen, T., Waldum, H. L., et al. (2002). Chronic exposure to carbon monoxide and nicotine: Endothelin ET (A) receptor antagonism attenuates carbon monoxide-induced myocardial hypertrophy in rat. *Toxicology and Applied Pharmacology, 178*, 8–14. doi:10.1006/taap.2001.9300
- Madden, P. A., Heath, A. C., Starmer, G. A., Whitfield, J. B., & Martin, N. G. (1995). Alcohol sensitivity and smoking history in men and women. *Alcoholism, Clinical and Experimental Research, 19*, 1111–1120. doi:10.1111/j.1530-0277.1995.tb01588.x
- Maxwell, J. (2005). *Qualitative research design: An interactive approach (Vol. 41)*. Thousand Oaks, CA: Sage Publications.
- McAllister-Sistilli, C. G., Caggiula, A. R., Knopf, S., Rose, C. A., Miller, A. L., & Donny, E. C. (1998). The effects of nicotine on the immune system. *Psychoneuroendocrinology, 23*, 175–187. doi:10.1016/S0306-4530(97)00080-2
- McNeil, A., Foulds, J., & Bates, C. (2001). Regulation of nicotine replacement therapies (NRT): A critique of current practice. *Addiction, 96*, 1757–1768. doi:10.1080/09652140120089508
- McQueen, A., Bartholomew, L. K., Greisinger, A. J., Medina, G. G., Hawley, S. T., Haidet, P., et al. (2009). Behind closed doors: Physician-patient discussions about colorectal cancer screening. *Journal of General Internal Medicine, 24*, 1228. doi:10.1007/s11606-009-1108-4
- Narahashi, T., Soderpalm, B., Ericson, M., Olausson, P., Engel, J. A., Zhang, X., et al. (2001). Mechanisms of alcohol-nicotine interactions: Alcoholics versus smokers. *Alcoholism, Clinical and Experimental Research, 25*(5 Suppl. ISBRA), 152S–156S. doi:10.1111/j.1530-0277.2001.tb02390.x
- National Vapers Club (2010). *Indoor vapor air quality study project*. Retrieved from <http://www.ivaqs.com/>
- Onoda, N., Nehmi, A., Weiner, D., Mujumdar, S., Christen, R., & Los, G. (2001). Nicotine affects the signaling of the death pathway, reducing the response of head and neck cancer cell lines to DNA damaging agents. *Head and Neck, 23*, 860–870. doi:10.1002/hed.1125
- Pauly, J., Li, Q., & Barry, M. B. (2007). Tobacco-free electronic cigarettes and cigars deliver nicotine and generate concern. *Tobacco Control, 16*, 357. doi:10.1136/tc.2006.019687
- Pidgeon, N. F., & Henwood, K. L. (1997). Using grounded theory in psychological research. In N. Hayes Ed. *Doing qualitative analysis in psychology* (pp. 245–273), Hove, UK: Psychology Press.
- Rose, J. E., Behm, F. M., & Levin, E. D. (1993). The role of nicotine dose and sensory cues in the regulation of smoke intake. *Pharmacology, Biochemistry and Behavior, 44*, 891–900. doi:10.1016/0091-3057(93)90021-K
- Schensul, J. (2008). *The Sage encyclopedia of qualitative research methods*. Thousand, Oaks, CA: Sage Publications.

Interviews with “vapers”

- Shiffman, S., Brockwell, S. E., Pillitteri, J. L., & Gitchell, J. G. (2008). Use of smoking-cessation treatments in the United States. *American Journal of Preventive Medicine*, *34*, 102–111. doi:10.1016/j.amepre.2007.09.033
- Sumner, W., 2nd (2005). Permissive nicotine regulation as a complement to traditional tobacco control. *BMC Public Health*, *5*, 18. doi:10.1186/1471-2458-5-18
- Surgeon General’s Report (2004). *New Surgeon General’s report expands list of diseases caused by smoking*, Retrieved from <http://archive.hhs.gov/news/press/2004pres/20040527a.html>
- Syversen, U., Nordsletten, L., Falch, J. A., Madsen, J. E., Nilsen, O. G., & Waldum, H. L. (1999). Effect of lifelong nicotine inhalation on bone mass and mechanical properties in female rat femurs. *Calcified Tissue International*, *65*, 246–249. doi:10.1007/s002239900692
- Trtchounian, A., Williams, M., & Talbot, P. (2010). Conventional and electronic cigarettes (e-cigarettes) have different smoking characteristics. *Nicotine & Tobacco Research*, *12*, 905–912. doi:10.1093/ntr/ntq114
- Vansickel, A. R., Cobb, C. O., Weaver, M. F., & Eissenberg, T. E. (2010). A clinical laboratory model for evaluating the acute effects of electronic “cigarettes”: Nicotine delivery profile and cardiovascular and subjective effects. *Cancer Epidemiology Biomarkers & Prevention*, *19*, 1945–1953. doi:10.1158/1055-9965.EPI-10-0288
- Vigneswaran, N., Tilashalski, K., Rodu, B., & Cole, P. (1995). Tobacco use and cancer. A reappraisal. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontics*, *80*, 178–182. doi:10.1016/S1079-2104(05)80199-4
- World Health Organization (2008). *Marketers of electronic cigarettes should halt unproved therapy claims*. Retrieved from <http://www.who.int/mediacentre/news/releases/2008/pr34/en/index.html>
- Wright, S. C., Zhong, J., Zheng, H., & Larrick, J. W. (1993). Nicotine inhibition of apoptosis suggests a role in tumor promotion. *FASEB Journal*, *7*, 1045–1051.
- Yamin, C. K., Bitton, A., & Bates, D. W. (2010). E-cigarettes: A rapidly growing internet phenomenon. *Annals of Internal Medicine*, *153*, 607–609.