



Electronic Cigarette and Electronic Hookah: A Pilot Study Comparing Two Vaping Products[☆]

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ABSTRACT

Since the introduction of e-cigarettes into the U.S. market, the number and variety of vaping products have proliferated. E-hookahs are long, pen-like vaping devices that debuted in U.S. markets in 2014. By applying the Host, Agent, Vector, Environment (HAVE) model, the objective of this exploratory study was to assess differences between e-cigarettes and e-hookahs to help inform tobacco regulatory science and practice. In June–August 2014, a total of 54 unique manufactured e-cigarette and e-hookah products were identified at point of sales (POS) around three college campuses in Southeast U.S. Documented characteristics included brand name, disposable, rechargeable, nicotine containing, packaging, and flavor type. Descriptive analyses were conducted October to November 2014 to assess frequency and percent of product type across POS and specific characteristics. Among 54 products, 70.4% was e-cigarettes and 29.6% was e-hookahs. Across POS, drug stores and grocery stores carried e-cigarettes exclusively, while gas stations carried the greatest proportion of e-hookahs. Compared to e-hookahs, a greater proportion of e-cigarettes were non-disposable and contained nicotine; a greater proportion of e-hookahs came in fruit and other types of flavors compared to e-cigarettes. The present study suggests that e-cigarettes and e-hookahs differ by specific product characteristics and by places where they are sold. Despite these differences, the products are used for similar purposes warranting careful monitoring of industry manufacturing and marketing, because the safety of both products is still undetermined. Additional research is needed to understand the uptake and continued use of these products.

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Introduction

Electronic nicotine delivery systems (ENDS) are battery-operated vaping devices that heat flavored nicotine liquid (although not all products are flavored or contain nicotine), which is inhaled as a vapor, similar to how traditional tobacco cigarettes are smoked. E-cigarettes have gained popularity among both youth and adults (King et al., 2013, 2014; Centers for Disease Control and Prevention, 2014, 2011–2012; Regan et al., 2013). The prevalence of ever trying e-cigarettes among adults increased significantly from 3.3% in 2010 to 8.5% in 2013 (King et al., 2014), a relative increase of 157%. Among youth, an alarming increase in use was observed in 2013, with 12% of U.S. high schools students reporting that they had ever tried e-cigarettes compared to 4.7% in 2011 (Centers for Disease Control and Prevention). Profound increases

in e-cigarette use by current and former users of conventional tobacco cigarettes was also detected (King et al., 2014). Currently e-cigarettes are unregulated at the Federal level, although Food and Drug Administration (FDA) has recently submitted proposed rules to extend their regulatory authority over e-cigarettes and other currently unregulated tobacco products.

The Framework Convention for Tobacco Control (FCTC) report on ENDS outlines two concerns regarding youth use of vaping products. First, the lack of regulation of vaping products may renormalize smoking, since the use of vaping products is practically indistinguishable from cigarette smoking; second, vaping products may be a gateway to nicotine dependence, particularly among non-nicotine dependent youth (World Health Organization, 2014). Additionally, the FCTC has provided Specific Regulatory Options around product design information and has indicated that ENDS solutions with fruit, candy-like and alcohol-drinks flavors should be banned until further scientific evidence indicates that youth are not attracted to using the products. While these FCTC recommendations focus on youth, the young adult population is also a vulnerable population traditionally targeted by the tobacco industry (Ling and Glantz, 2002). Youth are inherently curious; this curiosity persists into young adulthood, increasing the propensity to experiment with novel products such as e-cigarettes (Sutfin et al., 2015). Therefore,

[☆] What this study adds: e-cigarettes are currently unregulated the number and variety of products have proliferated. This pilot study provides data on a newly introduced vaping product, electronic hookah, and distinguishes it from e-cigarettes. The preliminary findings from this pilot study may inform tobacco regulatory science and practice by providing new insights for future research investigations examining vaping product characteristics and uptake, product safety, and approaches to enhancing surveillance.

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the FTC recommendations for youth should necessarily expand to include the young adult population. Finally, the FTC report also includes a recommendation that governments use, strengthen, and enhance existing tobacco surveillance systems to accurately monitor developments in ENDS and nicotine use (World Health Organization, 2014).

Recent developments in ENDS that are noteworthy include the proliferation and introduction of novel designs and brands of manufactured vaping products into U.S. markets. Until now, e-cigarettes have been most popular because they look and resemble traditional tobacco cigarettes; however, the electronic hookah (e-hookah) debuted in 2014 across U.S. markets. E-hookahs are used in the same manner as e-cigarettes, but differ in design and appearance; most e-hookahs are shaped as pens and come in a variety of flavors. At present, little is known about e-hookahs including where they are sold and how they might differ from e-cigarettes (National Institutes of Health).

Studies of e-cigarette availability at brick and mortar (BM) point of sales (POS) have been conducted to understand availability of ENDS (Grana and Ling, 2014; Rose et al., 2014). Rose et al. (2014), conducted an assessment of a nationally representative sample of retail outlets in the U.S., which indicated that e-cigarettes were more likely to be sold in drug stores, gas/convenience stores, and tobacco stores than in alcohol retail outlets (Rose et al., 2014). Moreover, the study reported that e-cigarettes were more likely to be available in neighborhoods with a high median household income and in neighborhoods with a lower proportion of African-Americans (Rose et al., 2014). A limitation of the study is that it did not assess e-hookah availability.

Given there is little knowledge about e-hookah product, we use the Host, Agent, Vector, Environment (HAVE) model (Grana and Ling, 2014), an infectious disease epidemiological framework adapted for tobacco control, to better understand emerging e-hookah product (World Health Organization, 2014). Applying the HAVE model, we assess the characteristics of e-cigarettes and e-hookahs (Agent) identified at BM POS (Environment) (Giovino, 2002). Following the FTC report (World Health Organization, 2014), this exploratory study sought to enhance our understanding of the development in vaping product landscape and build our knowledge base by investigating the following: 1) where are manufactured products sold? 2) what product types are available at POS? and 3) what are the design and characteristics of manufactured vaping devices? More detailed information about where products are sold and the product characteristics is needed to help inform tobacco regulatory science and practice (World Health Organization, 2014).

Methods

The present study is based upon a three-phase pilot study entitled, “Understanding the E-Cigarette Landscape: An Environmental Scan of Point of Sales (POS) and Website Forums” conducted as part of the Georgia State University (GSU) Tobacco Center of Regulatory Science (TCORS) (Dube et al., 2014). Three specific aims include: 1) to assess where e-cigarette users purchase their products through a content analysis of web forum blogs; 2) to conduct environmental scans at “brick and mortar (BM)” (POS) identified in Phase 1 to characterize product configurations; 3) to use data from Phases 1 and 2 to inform the development of novel survey measures about vaping devices. The current study focuses on Phases 1 and 2. GSU IRB approval was obtained and determined to be exempt for these phases of the pilot study.

In the summer of 2014 (June–August), two web-based e-cigarette and vapor forums were identified through an internet search. Both of these web forums are publicly available and include existing blogs from e-cigarette users. BM POS for the environmental scan were identified from content analysis of existing blogs from web-based e-cigarette and vapor forums, where e-cigarette users can discuss and share their experiences publicly online. Two research assistants collected the blogs from two separate web forums. Content analysis indicated that e-cigarette users purchase their devices from six types of POS:

1) specialty stores – vape, tobacco, smoke shops; 2) Walmart; 3) gas stations/convenience stores; 4) drug stores; 5) shopping mall; 6) grocery store. The six specific types of POS were used as inclusion criteria to map all possible sites within a 1-, 2-, and 3-mile radius around Georgia State University (GSU), Georgia Tech University (Ga Tech), and the University of Georgia (UGA). The total number of POS was 42 and made up the sampling frame: 18 at GSU, 14 at Ga Tech, and 10 at UGA. Our content analysis findings did not detect that e-cigarette users identified alcohol retail outlets as POS where they purchased their devices (Rose et al., 2014). Assessing vaping product availability in POS surrounding college campuses can provide information about where young adults can access and purchase products, since they tend to study, work, and/or reside around these locations.

A total of 8 POS were randomly selected from each campus (total = 24). As part of the protocol, the field researchers were instructed to carry out environmental scans during peak daylight hours and to avoid any POS if there were safety issues. As a result, 9 POS were excluded: 5 POS did not carry any manufactured vaping devices; 3 POS carried customizable vaping devices and stand-alone e-liquids; 1 POS was deemed unsafe to enter. Therefore the final dataset for manufactured products included 15 POS (62.5%): gas stations (3), drug stores (2), grocery stores (2-different chains), specialty stores (5-tobacco and ENDS), and other stores (3-Walmart, mall store).

Manufactured ENDS product characteristics

In order to characterize the manufactured vaping devices, two field researchers conducted POS scans together. Pictures of products were obtained at each POS and each field researcher provided individual observations on the characteristics of vaping devices. A total of 54 unique manufactured products from the 15 POS were observed by the two field researchers. Data were coded and entered for each researcher. If the pictures provided incomplete view of the product, then product characteristics were coded as missing. Photography to evaluate retail outlets has been documented as a rapid method to accurately capture information on marketing advertisements (Ilakkuvan et al., 2014). Characteristics that were observed and recorded for the manufactured products include the following:

Manufactured vaping devices: vaping devices defined as e-cigarette or e-hookah.

Brand names: branded names of manufactured products. Assessing and documenting brand names provides the field with specific information about what is currently available at POS and can inform further research around marketing tactics.

Disposability: a variable with three mutually exclusive groups for product disposability was created: disposable only, non-disposable only, and either disposable or non-disposable. Disposable indicates products that are thrown out after usage, whereas non-disposable indicates the product that can be recharged or refilled; some brands have the option of being purchased as either disposable or non-disposable.

Contains nicotine: products marked with nicotine concentration greater than 0.

Packaging: three types of packaging: 1) traditional cigarette style pack – products sold in packaging that resembled tobacco cigarette package. 2) Plastic packaging – defined as products packaged in any type of clear plastic covers. 3) Pen box – defined as products packaged in long slender boxes.

Flavor type: five flavor categories: 1) tobacco and menthol; 2) desserts and candies; 3) fruits; 4) drinks; and 5) others. It should be noted that for the purposes of ENDS products, combining tobacco and menthol was meant to indicate that these electronic devices are marketed with these distinct types of flavorings to mimic traditional tobacco products. In this definition, menthol is still considered as an unregulated flavor.

Age restriction on package: warning label that indicated that product was restricted to use by persons under the age of 18 years.

Inter-rater reliability statistics were computed to assess consistency on the observed product characteristics (N = 54). Cohen's Kappa obtained ranged from .60 (nicotine containing product) to .91 (type of vaping device), which constitutes moderate to excellent range (Landis and Koch, 1977).

Statistical analysis

All analyses were descriptive using frequencies and cross-tabulations. For some products, observations on characteristics were undetermined and missing, thereby reducing the sample size in some of the analyses. All statistical analyses were conducted between October and December 2014 using SPSS v21.

Results

Across three college campuses, the mean number of miles from campus to each type of POS was 0.41 mi for tobacco and vaping device specialty stores, 0.54 mi for gas stations, 0.70 mi for malls, 1.2 mi for grocery stores, 1.3 for other stores (Walmart), and 2.1 mi for drug stores. Of the 54 manufactured products identified, the majority was identified as e-cigarettes (70.4%); the remainder (29.6%) was identified as e-hookahs. By distance, 100% of the e-hookah products were available within a 1-mile radius of campus and 55% of e-cigarettes were available within a 1-mile radius (data not shown). The proportion of vaping devices observed by POS was 29.6% at gas stations, 22.2% at specialty stores, 22.2% from other stores, 16.7% at drug stores, 5.6% at grocery stores, and 3.7% at malls (Table 1).

Product characteristics across POS

Drug stores and grocery stores carried e-cigarettes exclusively (100%) (Table 1). Of the products observed, drug stores carried a greater proportion of either disposable or non-disposable formats. Of the 29 products for which nicotine content data were available, 100% of the products with nicotine were sold in drug stores and grocery stores (Table 1).

Traditional cigarette packaging was predominantly found in drug stores (88.9%), plastic packaging was primarily found in gas stations (43.8%), and two out of the three products found at grocery stores (66%) were observed to be in pen boxes (Table 1). Of the 41 manufactured products for which flavors were documented, tobacco and menthol were primarily found in drug stores, grocery stores, and other stores. Dessert and candy flavors were primarily found in drug stores and other flavors were primarily found in specialty stores. Gas stations carried the greatest proportion of fruit and drink flavors (Table 1).

Brand names of e-cigarettes and e-hookahs indicated a total of 23 e-cigarette brands and 12 e-hookah brands (Table 2). Drug stores and grocery stores did not carry any e-hookahs. The most frequently identified e-cigarette brand was Blu followed by Njoy and Fin. The most frequently reported e-hookah brand was Fantasia (Table 2).

E-cigarette and e-hookah products significantly differed on several characteristics. The majority of e-hookah products (94%) in this sample of vaping products were identified as disposable compared to 40% of e-cigarettes, 6% of e-hookahs were either disposable or non-disposable formats; none of the e-hookah was non-disposable (Table 3). A smaller proportion of e-hookahs contained nicotine, 8.3% compared to 94.1% of e-cigarettes (Table 3). Only e-cigarettes were identified as coming in traditional cigarette packaging; the majority of e-hookahs (81.3%) came in long boxes similar to how pens are packaged compared to 21.1% of e-cigarettes. For flavor types, 88.5% of e-cigarettes came in tobacco or menthol flavors compared to 40% of e-hookahs. However, compared to e-cigarettes, a greater proportion of e-hookahs came in fruit (80.0%) and other types of flavors (66.7%). Age restrictions on package were observed on 83% of e-cigarette products versus 50% on e-hookah products (Table 3).

Discussion

The present study is one of the first pilot investigations conducted in a Southeast U.S. state that identified retail outlets around college campuses that sell manufactured vaping devices and identified characteristics of the manufactured vaping devices. Based on the preliminary findings, vaping devices are available at gas stations, drug stores,

Table 1
Distribution of vaping device characteristics by select POS in Southeast U.S., June–August 2014.

| Vaping device characteristics (N = 54) ^a | Total N (%) | Point of sales | | | | |
|---|-------------|----------------|-----------------|-------------------|----------------------------------|------------------------------|
| | | Drug store (2) | Gas station (3) | Grocery store (2) | Specialty store ¹ (5) | Other store ² (3) |
| <i>Product Type (54)</i> | | | | | | |
| E-cigarette | 38 (70.4%) | 9 (100%) | 8 (50%) | 3 (100%) | 7 (58.3%) | 11 (78.6%) |
| E-hookah | 16 (29.6%) | 0 | 8 (50%) | 0 | 5 (41.7%) | 3 (21.4%) |
| <i>Disposable only (53)</i> | | | | | | |
| Disposable only (53) | 30 (56.6%) | 3 (33.3%) | 11 (68.8%) | 2 (66.7%) | 6 (54.5%) | 8 (57.1%) |
| <i>Non-disposable only (53)</i> | | | | | | |
| Non-disposable only (53) | 16 (30.2%) | 2 (22.2%) | 5 (31.3%) | 1 (33.3%) | 5 (45.5%) | 3 (21.4%) |
| <i>Both disposable and non-disposable (53)</i> | | | | | | |
| Both disposable and non-disposable (53) | 7 (13.2%) | 4 (44.4%) | 0 | 0 | 0 | 3 (25%) |
| <i>Nicotine containing (29)</i> | | | | | | |
| Nicotine containing (29) | 17 (58.6%) | 6 (100%) | 3 (27.3%) | 2 (100%) | 2 (50%) | 4 (66.7%) |
| <i>Packaging (53)</i> | | | | | | |
| Traditional cigarette style box or other box | 20 (37.7%) | 8 (88.9%) | 1 (6.3%) | 1 (33.3%) | 3 (25%) | 7 (50%) |
| Plastic packaging | 12 (22.6%) | 0 | 7 (43.8%) | 0 | 4 (33.3%) | 1 (8.3%) |
| Pen box | 21 (39.6%) | 1 (11.1%) | 8 (50%) | 2 (66.7%) | 4 (33.3%) | 6 (42.9%) |
| <i>Flavor types^b (41)</i> | | | | | | |
| Tobacco and menthol flavors | 29 (70.7%) | 7 (87.5%) | 6 (46.2%) | 2 (100%) | 3 (50%) | 11 (91.7%) |
| Dessert and candy flavors | 5 (12.2%) | 2 (25%) | 1 (7.7%) | 0 | 0 | 2 (20%) |
| Fruit flavors | 16 (39.0%) | 2 (25%) | 7 (53.8%) | 0 | 3 (50%) | 4 (33.3%) |
| Drink flavors | 10 (24.4%) | 1 (12.5%) | 5 (38.5%) | 0 | 2 (33.3%) | 2 (20%) |
| Other types of flavors | 12 (29.3%) | 1 (12.5%) | 4 (30.8%) | 1 (50%) | 4 (66.7%) | 2 (16.7%) |
| <i>Total products</i> | 54 | 9 (16.7%) | 16 (29.6%) | 3 (5.6%) | 12 (22.2%) | 14 (25.9%) |

¹ Includes tobacco outlets and vape outlets.

² Includes stores other than drug, pharmacy, grocery, or specialty.

^a Data on some characteristics missing for some products, therefore, sample sizes may vary.

^b There were a total of 41 products. One discrete product could have more than one flavor, therefore frequencies for flavor type will not add up to the total number of products found in the specific POS.

Table 2
Frequency count of e-cigarette and e-hookah brand by POS in Southeast U.S., June–August, 2014.

| E-cigarette brand name | Drug store (2) | Gas station (3) | Grocery store (2) | Mall (1) | Specialty store ¹ (5) | Other store ² (2) | Total |
|----------------------------|----------------|-----------------|-------------------|----------|----------------------------------|------------------------------|-------|
| Blu | 2 | 2 | | 1 | | 2 | 7 |
| CE4 | | 1 | | | | | 1 |
| Cigirex | | | 1 | | | | 1 |
| E-Cigarette | | 1 | | | 1 | | 2 |
| eCg-E9 | | | | | 1 | | 1 |
| EZ Cig | | | | | 1 | | 1 |
| Fin | 2 | | | | | 1 | 3 |
| Finiti | 1 | | | | | | 1 |
| Flavor Vapes | | 1 | | | | | 1 |
| Haus | 1 | | | | | 1 | 2 |
| MARKTEN | | | 1 | | | | 1 |
| Metro | | | | | 1 | | 1 |
| Mistic | 1 | | | | | 1 | 2 |
| Never Light Again-Goliath2 | | | | | 1 | | 1 |
| Nicstick Ego Pro | | | | | 1 | | 1 |
| Njoy | 2 | | 1 | | | 1 | 4 |
| PlayBoy | | | | | | 1 | 1 |
| Quick Draw | | | | | 1 | | 1 |
| reJuve | | 1 | | | | | 1 |
| V2 | | | | | | 1 | 1 |
| VaporX | | 1 | | | | 1 | 2 |
| Viking | | 1 | | | | | 1 |
| Zoom | | | | | | 1 | 1 |
| Total | 9 | 8 | 3 | 1 | 7 | 10 | 38 |
| E-hookah brand name | Drug store | Gas station | Grocery store | Mall | Specialty store ¹ | Other store ² | Total |
| Ali Baba | | 1 | | | | | 1 |
| Amazing | | 1 | | | | | 1 |
| Elite | | | | | 1 | | 1 |
| Exo | | | | | | 1 | 1 |
| Fantasia | | 2 | | | 1 | | 3 |
| Flavor Vapes | | 1 | | | | | 1 |
| Hemp Hookahzz | | | | | 1 | | 1 |
| HiFi | | 1 | | | | | 1 |
| HiTech | | 1 | | | | 1 | 2 |
| Imperial Hookah | | | | | 1 | | 1 |
| Magic Stick | | 1 | | | 1 | | 2 |
| Voodoo | | | | 1 | | | 1 |
| Total | 0 | 8 | 0 | 1 | 5 | 2 | 16 |

¹ Includes tobacco outlets and vape outlets.

² Includes stores other than drug, pharmacy, grocery, or specialty.

grocery stores, tobacco and vape specialty stores, and Walmart. The majority of manufactured products identified in the present POS scans were e-cigarettes; the greatest proportions of e-cigarettes with packaging and tobacco and menthol flavors that emulate traditional tobacco cigarettes were found in drug stores. In most drug stores, tobacco cigarettes and other tobacco products are kept together at the front counter, therefore, the most logical marketing tactic for e-cigarettes is to sell them in similar packaging and flavors and display them next to traditional tobacco products. Displaying e-cigarette packaged in boxes that resemble traditional tobacco cigarettes may possibly make them more appealing to consumers, especially among current and former tobacco cigarette smokers, where prevalence of e-cigarette use has increased over time (King et al., 2014). Of course, as with any exploratory study, the aforementioned are proposed theories and additional research is needed to properly assess consumer perceptions about product characteristics.

In addition to identifying e-cigarettes, e-hookahs were another type of frequently observed manufactured products at POS. Gas stations and specialty stores were the predominant carrier of e-hookahs. Differences in the product characteristics were observed. E-hookahs, which are long pen-like devices, were not configured as e-cigarettes in that they were observed as non-nicotine containing products that came in fruit or other flavors. In addition, it is important to mention that e-hookahs were sold in POS that were within an average of a 1-mile distance

within college campuses making them convenient to access. Also products with fruit or drink flavors were sold in POS closer to the campuses such as gas stations. Gas stations and convenience stores may be more lax in sales to minors than larger drug store chains and those containing pharmacies. Given that a lesser proportion of e-hookahs contained nicotine compared to e-cigarettes, it is possible that these products may be used primarily for flavors and not for the nicotine. Further research is needed to assess reasons for using non-nicotine products.

Non-nicotine products may seem benign, but studies of puffing topography and carbon monoxide exposure from traditional hookah waterpipes that compare non-nicotine and nicotine shisha may contradict this idea. Shishani et al., 2014 found that waterpipe smokers of non-nicotine and nicotine shisha differed on puffing topography, where nicotine dependent waterpipe smokers had shorter puff times and less volume when puffed, compared to non-nicotine waterpipe smokers (Ilakkuvan et al., 2014). In addition, they reported that mean carbon monoxide (CO) levels increased from pre-smoking to post-smoking among the nicotine and the non-nicotine groups, however, the non-nicotine condition had the largest change in mean CO levels (Shishani et al., 2014). Based on these findings, the authors proposed that non-nicotine dependent waterpipe smokers may be compensating for nicotine dependency through puffing topography, which may lead to greater levels of carbon monoxide (CO) (Shishani et al., 2014). The tobacco-free shisha sold for traditional hookah waterpipes is marketed

Table 3
Characteristics of E-cigarettes and E-hookah in Southeast U.S., June–August, 2014 (N = 54).

| Vaping device characteristics | Type of vaping device | |
|--|-------------------------|----------------------|
| | E-cigarette (n = 38) | E-hookah (n = 16) |
| Disposable only ^b | 40.5% | 93.8% |
| non-disposable only | 43.2% | 0 |
| Both disposable and non-disposable ENDS ^a | 16.3% | 6.2% |
| Nicotine containing ENDS | 94.1% | 8.3% |
| Packaging | | |
| Traditional cigarette style | 52.6% | 0 |
| Box or other box | | |
| Plastic packaging | 23.7% | 18.8% |
| Pen box | 21.1% | 81.3% |
| Flavor types | | |
| Tobacco and menthol flavors | 88.5% | 40.0% |
| Dessert and candy flavors | 11.5% | 13.3% |
| Fruit flavors | 15.4% | 80.0% |
| Drink flavors | 15.4% | 40.0% |
| Other types of flavors | 7.7% | 66.7% |
| Age restrictions on package | 83.3% | 50.0% |

^a Some brands of e-cigarettes give consumer the option to purchase either disposable or non-disposable option.

^b Disposability is three mutually exclusive groups; n = 37 for e-cigarettes.

as “safer” than tobacco shisha. E-hookahs are also currently marketed as safer because they do not contain nicotine. Currently the National Library of Medicine has posted a website through Medline indicating that the safety of use of these vaping devices, even those with zero nicotine is still unknown (Ling and Glantz, 2002). Moreover, a search on Pubmed for studies on e-hookah resulted in no hits. Therefore, future studies need to examine e-hookahs in terms of their use as well as product safety.

The present study also found that e-cigarettes and e-hookahs differed on flavor types. It is not surprising that a larger percent of e-cigarettes were tobacco or menthol flavored compared with e-hookahs. Since the introduction of e-cigarettes into the U.S. markets, manufacturers have tried to portray e-cigarettes as an alternative to combustible smoking. On the other hand, a greater proportion of e-hookahs were fruit and other flavors compared to e-cigarettes; this closely resembles flavored shisha sold for the traditional hookah or waterpipe.

The idea of flavored nicotine products is not a new marketing concept. In the 2012 Surgeon General's Report, Chapter 5 outlines in detail how the tobacco industry willfully conceptualized the use of flavors, such as cola and apple as a way to attract and interest young, regular cigarette smokers (U.S. Department of Health and Human Services, 2012). As discussed in tobacco industry documents, the industry has known that “sweet” flavor additives can lure youth into using tobacco, thereby propagating nicotine dependence (U.S. Department of Health and Human Services, 2012). In 2009, the Family Smoking Prevention and Tobacco Control Act prohibited flavors (except menthol) in cigarettes and smokeless tobacco. (Landis and Koch, 1977) While additional research is needed to assess the impact of vaping flavors on youth uptake (World Health Organization, 2014), FDA should carefully consider the mass number of flavors currently available that portrays the vaping industry as a “candy shop”. If flavors are not regulated, it is particularly important to prohibit youth access to certain vaping products. As of September 2015, 47 states and 2 territories in the U.S. prohibited sales of e-cigarettes to minors (National Conference of State Legislatures). Additional strategies that are needed are prohibiting access to POS for minors, and most importantly, restricting internet sales.

Beginning in July 2014, Georgia law deemed it illegal to sell or distribute any e-cigarette products, including e-hookahs and pens to persons under 18 years old. As demonstrated in this study and observed by advocacy groups, vaping devices are typically available in a variety of flavors, which may be appealing to children and young adults

(Georgia Department of Public Health). These products are also configured to look like pens or other small objects that can be concealed within backpacks and clothing. While the vapor released when using the device may appear to be harmless, it actually may include toxic substances such as formaldehyde, propylene glycol, acetaldehyde, acrolein, lead, and tobacco-specific nitrosamines in addition to nicotine (Georgia Department of Public Health). Due to the 1169 calls that were made to the Georgia Poison Center (GPC) from 2009 to 2014 for exposures or poisonings from products containing tobacco or nicotine, it is imperative that all persons in contact with children be aware of the potential harmful effects of vaping devices and their constituents and urge caution about the use and exposure of children and young adults to the products and their emissions (Georgia Department of Public Health; Centers for Disease Control and Prevention, 2010–2014).

Limitations

The current study has several limitations. First, the study only collected data from POS at three specific college campuses in Georgia. Second, the findings may not be applicable in states where marijuana has been legalized because vape shops in those states may be vastly different in terms of product configuration. Third, data were collected in June to August 2014 and therefore may not completely reflect what is currently available. However, given that no significant changes in e-cigarette product regulation have taken place, it is likely that the findings in this pilot may be relevant currently. Fourth, data collection took place when Georgia law deemed it illegal to sell or distribute any e-cigarette products, including e-hookahs and pens, to persons under 18 years old. Compliance check data were unavailable for the areas where POS scans were conducted. Future studies at POS should include data on compliance checks where available. These aforementioned limitations do not permit us to generalize our findings on availability and characteristics of e-cigarettes and e-hookah to all products found in Georgia and the U.S. Also, attention is needed when interpreting the overall frequency at which e-cigarettes and e-hookahs were available at POS, since other products were not identified. In this context, selection bias may lead to the interpretation that e-cigarettes and e-hookah are the only products available, when in fact this is not the case. Despite the limitations of this pilot study, the preliminary findings provide new knowledge around the evolving ENDS product landscape. Furthermore, the findings from this non-representative study may inform larger investigations using methodology that may provide more interpretable and generalizable findings to validate the present findings and fully investigate the ENDS landscape.

Summary and conclusions

The findings from this pilot study of manufactured products indicate that in addition to e-cigarettes, other devices such as e-hookahs are also available but vary significantly with respect to specific characteristics, such as packaging and nicotine content. While the majority of e-hookahs do not contain nicotine the safety of the products is unknown at this time and another important characteristics of this emerging market is that they came in an assortment of flavors. Constituents of e-liquids, such as flavors have been shown to be toxic (Bahl et al., 2012; Behar et al., 2014). The findings from this study can be used to inform future research and surveillance efforts that focus on the epidemiology of novel tobacco product use, including product related factors associated with the decision to initiate and continue use. Until more is known about the safety of all vaping devices, the public health community needs to continue efforts to educate the public about the undetermined health effects of these products and limit access of these products to adolescents and youth. As a first step, knowing the environmental landscape by assessing specific retail outlets that sell vaping devices is critical for post-market surveillance and research efforts.

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Conflict of interest statement

The authors of this manuscript have no competing interests and no conflicts of interest to disclose.

Transparency document

The Transparency document associated with this article can be found, in the online version.

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References

- Bahl, V., Lin, S., Xu, N., Davis, B., Wang, Y., Talbot, P., 2012. Comparison of electronic cigarette refill fluid cytotoxicity using embryonic and adult models. *Reprod. Toxicol.* 34, 529–537. <http://dx.doi.org/10.1016/j.reprotox.2012.08.001>.
- Behar, R.Z., Davis, B., Wang, Y., Bahl, V., Lin, S., Talbot, P., 2014. Identification of toxicants in cinnamon-flavored electronic cigarette refill fluids. *Toxicol. in Vitro* 28, 198–208.
- Centers for Disease Control and Prevention, 2014. Tobacco Use Among Middle and High School Students, United States, 2013 Available at: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6345a2.htm?s_cid=mm6345a2_e.
- Centers for Disease Control and Prevention, b. Notes from the Field: Electronic Cigarette Use Among Middle and High School Students, United States, 2011–2012 Available at: <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6235a6.htm>.
- Centers for Disease Control and Prevention, 2010–2014. Notes from the Field: Calls to Poison Centers for Exposures to Electronic Cigarettes. United States, MMWR Available at: <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6313a4.htm>.
- Dube, S.R., Pathak, S., Koncul, J., Eriksen, M., 2014. FDA Response Submission: FDA Should Regulate All E-Cigarettes, Electronic Nicotine Delivery Systems (ENDS), Zero Nicotine Electronic Devices (ZNEDS), and Associated Parts and Components as Covered Tobacco Products.
- Georgia Department of Public Health, d. Sale of Electronic Cigarettes Illegal to Minors in Georgia Available at: <http://dph.georgia.gov/press-releases/2014-07-01/sale-electronic-cigarettes-illegal-minors-georgia> (Accessed March 20, 2015).
- Giovino, G.A., 2002. Epidemiology of tobacco use in the United States. *Oncogene* 21 (48). <http://dx.doi.org/10.1038/sj.onc.1205808>.
- Grana, R.A., Ling, P.M., 2014. Smoking revolution. *Am. J. Prev. Med.* 46 (4), 395–403. <http://dx.doi.org/10.1016/j.amepre.2013.12.010>.
- Ilakkuvan, V., Tacelesky, M., Ivey, K.C., et al., 2014. Cameras for public health surveillance: a methods protocol for crowdsourced annotation of point-of-sale photographs. *JMIR Res. Protoc.* 3 (2), e22. <http://dx.doi.org/10.2196/resprot.3277>.
- King, B.A., Alam, S., Promoff, G., Arrazola, R., Dube, S.R., 2013. Awareness and ever-use of electronic cigarettes among U.S. adults, 2010–2011. *Nicotine Tob. Res.* 15 (9), 1623–1627. <http://dx.doi.org/10.1093/ntr/ntt013>.
- King, B.A., Patel, R., Nguyen, K.H., Dube, S.R., 2014. Trends in awareness and use of electronic cigarettes among U.S. adults, 2010–2013. *Nicotine Tob. Res.* <http://dx.doi.org/10.1093/ntr/ntu191>.
- Landis, J.R., Koch, G.G., 1977. The measurement of observer agreement for categorical data. *Biometrics* 33, 159–174.
- Ling, P.M., Glantz, S.A., 2002. Why and how the tobacco industry sells cigarettes to young adults: evidence from industry documents. *Am. J. Public Health* 92 (6), 908–916.
- National Conference of State Legislatures, d. Alternative Tobacco Products/Electronic Cigarettes Accessed October 5, 2015 at <http://www.ncsl.org/research/health/alternative-nicotine-products-e-cigarettes.aspx>.
- National Institutes of Health, d. E-cigarettes and E-hookahs Available at <http://www.nlm.nih.gov/medlineplus/ency/patientinstructions/000761.htm> (Accessed March 20, 2015).
- Regan, A.K., Promoff, G., Dube, S.R., Arrazola, R., 2013. Electronic nicotine delivery systems: adult use and awareness of the “e-cigarette” in the USA. *Tob. Control.* 22 (1), 19–23. <http://dx.doi.org/10.1136/tobaccocontrol-2011-050044>.
- Rose, S.W., Barker, D.C., D’Angelo, H., et al., 2014. The availability of electronic cigarettes in US retail outlets, 2012: results of two national studies. *Tob. Control.* 23 (Suppl. 3), iii10–iii16. <http://dx.doi.org/10.1136/tobaccocontrol-2013-051461>.
- Shishani, K., Howell, D., McPherson, S., Roll, J., 2014. Young adult waterpipe smokers: smoking behaviors and associated subjective and physiological effects. *Addict. Behav.* 39 (6), 1113–1119. <http://dx.doi.org/10.1016/j.addbeh.2014.03.010> (Jun).
- Sutfin, E.L., Reboussin, B.A., Debinski, B., Wagoner, K.G., Spangler, J., Wolfson, M., 2015. The impact of trying electronic cigarettes on cigarette smoking by college students: a prospective analysis. *Am. J. Public Health* 105 (8), e83–e89. <http://dx.doi.org/10.2105/AJPH.2015.302707>.
- U.S. Department of Health and Human Services, 2012. Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, Atlanta, GA.
- World Health Organization, 2014. Electronic Nicotine Delivery Systems Available at www.who.int/ctc/publications (July 21).