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Patterns of nicotine concentrations in electronic cigarettes sold in the United States, 2013–2018

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Abstract

Introduction: Considerable declines in cigarette smoking have occurred in the U.S. over the past half century. Yet emerging tobacco products, including e-cigarettes, have increased in popularity among U.S. youth and adults in recent years. Nicotine content is an important factor in weighing the potential benefits and risks of e-cigarettes on individual and population level health. This study examined how nicotine concentrations of e-cigarette products sold have changed from 2013 to 2018.

Methods: E-cigarette sales data aggregated in 4-week periods from March 2, 2013 to September 8, 2018 (66 months total) from convenience store and mass market channels were obtained from Nielsen. Internet and vape shop sales were not available. Internet searches were used to supplement information for nicotine concentration and flavor. Products were categorized by nicotine concentration, flavor, type (disposable or rechargeable), and brand. Dollar sales, unit sales, and average nicotine concentration were assessed.

Results: During 2013–2018, the average nicotine concentration in e-cigarettes sold increased overall, for all flavor categories, and for rechargeable e-cigarettes. The proportion of total dollar sales comprised of higher nicotine concentration e-cigarettes (> 4% mg/mL) increased from 12.3% to 74.7% during 2013–2018, with a similar increase in unit share. Zero-nicotine products accounted for less than 1% of dollar market share across all years analyzed.

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Contributors

All authors were involved in the conceptualization of the study and design of analyses. E Miller Lo and H Xiao implemented the data analyses. All authors collaborated on the interpretation of findings and placement in context. The manuscript was drafted by E Miller Lo, A Cuccia, A Romberg, K Marynak, and B King, and all authors were responsible for significant revisions and refinement of the manuscript's content. All authors read and approved the final manuscript.

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Declaration of Competing Interest

No conflict declared.

Conclusions: E-cigarettes with higher nicotine concentrations comprise a substantial and increasing portion of U.S. e-cigarette sales. Higher nicotine concentrations may influence patterns of e-cigarette use, including harms from e-cigarette initiation among youth and potential health benefits for adult smokers switching completely to e-cigarettes.

Keywords

E-cigarettes; Nielsen; Sales; Flavors

1. Introduction

Considerable declines in cigarette smoking have occurred among U.S. adults and adolescents over the past half century, representing a significant public health achievement (US Department of Health and Human Services, 2012; [HHS] et al., 2014; Johnston et al., 2018). However, emerging tobacco products, including e-cigarettes, have increased in popularity among U.S. youth and adults in recent years (HHS et al., 2016; King et al., 2015; Schoenborn and Gindi, 2015; Schoenborn and Clarke, 2017). Past-30 day use of e-cigarettes increased substantially among U.S. high school students during 2011–2015, and since 2014, e-cigarettes have been the most commonly used tobacco product among high school students (Cullen et al., 2018). Past-30 day e-cigarette use among high school students declined for the first time in 2016 (11.3%) and remained stable in 2017 (11.7%). However, use surged during 2017–2018, with 20.8% of high school students reporting past-30 day e-cigarette use in 2018 (Cullen et al., 2018). In contrast, prevalence of e-cigarette use has declined in recent years among U.S. adults, from 3.5% in 2015 to 2.8% in 2017 (Wang et al., 2018).

Both potential benefits and potential risks should be considered when determining e-cigarettes' population level net public health effects. A 2018 Report of the National Academies of Science, Engineering, and Medicine found there is conclusive evidence that completely substituting e-cigarettes for combustible tobacco cigarettes reduces users' exposure to numerous toxicants and carcinogens present in combustible tobacco cigarettes (NASEM, 2018). However, the report also found conclusive evidence that in addition to nicotine, most e-cigarette products contain and emit numerous potentially toxic substances (NASEM, 2018). Furthermore, in 2016, the U.S. Surgeon General concluded that e-cigarette aerosol is not harmless, and that nicotine exposure during adolescence can cause addiction and can harm the developing adolescent brain (HHS et al., 2016). Thus, e-cigarettes have the potential to benefit adult smokers if used as a complete substitute for combustible products, but are not safe for youth, young adults, pregnant women, or adults who do not currently use tobacco products (HHS et al., 2016).

Nicotine content in e-cigarettes is an important factor in weighing the potential benefits and risks of e-cigarettes. Nicotine content and speed of nicotine delivery may influence both the rate at which adult smokers switch to e-cigarettes and the rate of initiation of e-cigarette use among youth (NASEM, 2018). Products with higher concentrations of nicotine may be more appealing to established adult smokers and facilitate complete switching; however, the available science on the effectiveness of e-cigarettes for promoting smoking cessation is presently inconclusive (NASEM, 2018). Higher nicotine concentrations may increase the

rate of nicotine addiction in youth and young adults, as well as the number of youth moving on to established smoking of combustible tobacco products. Further, products with higher concentrations of nicotine may pose greater health risk by heightening the detrimental impact of nicotine on brain development for adolescent users or infants exposed prenatally (HHS et al., 2016; England et al., 2015).

While some e-cigarette brands offer nicotine-free products, 99% of e-cigarette products sold in U.S. convenience stores and mass retail locations in 2015 contained nicotine, (Marynak et al., 2017a) and products labeled as 0% or < 1% nicotine constituted < 2% of sales during 2013–2015 (Day et al., 2017). Over that same time period, the percentage of sales attributed to products with 4.0–4.9% nicotine, the highest available at the time, increased from 12.3% to 33.5% (Day et al., 2017). More recently introduced products have featured higher nicotine concentrations. For example, NJOY, which offers a variety of nicotine concentrations, sells some products with 6% nicotine. In September 2018, JUUL e-cigarettes accounted for the majority of e-cigarette sales in the U.S (Herzog and Kanada, 2018). JUUL entered the market in 2015 with a USB shaped e-cigarette and nicotine "pods," that, until August 2018, were exclusively available in a 5% concentration. The manufacturer has stated that the amount of nicotine in a single JUUL 5% pod is equivalent to about a single pack of conventional cigarettes (JUUL.com, 2018a). JUUL held approximately 75% of the U.S. e-cigarette market share by December 2018 and has been cited as a major contributor to the 78% increase in prevalence of e-cigarette use among U.S. high school students that occurred during 2017–2018 (Cullen et al., 2018; Jackler and Ramamurthi, 2019). JUUL contains nicotine salts, which allow particularly high levels of nicotine to be inhaled more easily and with less irritation than the free-base nicotine that has traditionally been used in tobacco products, including e-cigarettes (Bowen and Xing, 2014). These high levels of nicotine, delivered in the form of nicotine salts, could enhance the efficiency of nicotine delivery and potentially increase the likelihood that adult smokers are able to use these products to quit smoking completely. On balance, these products are of particular concern for young people, because it could make it easier for them to initiate the use of nicotine through these products and also could make it easier to progress to regular e-cigarette use and nicotine dependence (HHS et al., 2018).

The dramatic changes in the e-cigarette market, (Cullen et al., 2018; King et al., 2018) the recent introduction of products with higher concentrations of nicotine, and the recent surge in e-cigarette use among youth, (Cullen et al., 2018) underscore that the availability to youth and young adults of e-cigarettes with high nicotine concentrations are of immediate public health concern and warrant remedial action. Therefore, this study assessed how nicotine concentrations of e-cigarette products have changed from 2013 to 2018, among brands, flavors, and product types, as reflected by both absolute and relative market shares.

2. Methods

2.1. Data source

E-cigarette sales data in the contiguous United States from March 2, 2013 through September 8, 2018 were obtained from the Nielsen Company. The data were available for independent, chain, and gas station convenience stores; and mass merchandisers including

supermarkets, discount stores such as Walmart, club stores such as BJ's and Sam's Club, dollar stores, and military commissaries. Nielsen uses a proprietary sample-based methodology to estimate representative sales data for retail outlets by using in-store barcode scanning equipment and in-person audits. The data included dollar and unit sales from cash register receipts, and product attributes such as brand, flavor, and nicotine concentration based on information supplied by product manufacturers and obtained from in-store audits by Nielsen staff. There were 1546 unique e-cigarette products in the dataset, including: disposable and rechargeable e-cigarettes, e-cigars, e-hookahs, and other nicotine delivery devices; refills and e-liquids; and accessories and replacement parts.

Since the 2018 data cover only 28 instead of 52 weeks, results for each section are reported first for the five 52-week periods from March 2, 2013 through February 24, 2018, and then for the 28 week period from February 24, 2018 to September 8, 2018.

2.2. Measures

2.2.1. Nicotine concentration—Nicotine concentration was reported by Nielsen for 75.4% of the unique e-cigarette products in the dataset; additionally, Internet searches were conducted to ascertain nicotine concentrations for the 380 products for which this attribute was missing from the Nielsen file. Nicotine concentration for 110 of these missing products was identified through an exact match for the product on the company's website. The nicotine concentration for an additional 88 missing products was found by matching the products to descriptions on other websites, including retailer websites, blogs, and social media. Seventy-two products were determined to be devices without refills, accessories, or replacement parts for e-cigarette products, and therefore would not include nicotine; these products were excluded from analyses related to nicotine and flavor content. Nicotine concentrations for 110 products could not be reliably identified. The 1364 liquid-containing products for which nicotine concentrations could be reliably identified accounted for 88.2% of the unique products in the dataset and 94%–99.5% of dollar sales (97%–99.8% of unit sales) over the assessed 66 months.

All nicotine concentrations were expressed as percentages, assuming reported mass (mg) as mg per mL of liquid (e.g., 24 mg = 2.4%) (El-Hellani et al., 2015).

2.2.2. Flavors—Products were classified into seven flavor categories: tobacco, menthol/mint, fruit, candy/sweet, beverages, other flavors, and not stated. The "other flavors" category included products that were flavored, but that were: 1) colors or other ambiguous names (e.g., "Yamato"); 2) multiple or assorted flavors; or 3) those that did not fit into the previously mentioned categories such as clove and cinnamon. The "Not Stated" category included products for which no flavor information was identified by Nielsen.

2.2.3. Top brands—Data were broken out separately for brands that accounted for 5% or greater of the dollar or unit market share in any year.

2.2.4. Product type—Products were grouped into two categories: disposable and rechargeable/refill. The disposable category included non-refillable, disposable e-cigarettes,

while the rechargeable/refill category included pod mod (e.g. JUUL) and tank starter kits with introductory refills, kits, accessories, and refill cartridges, and e-liquids.

2.3. Analysis

Total dollars and units were calculated. All unit sales analyses used Nielsen's reported standardized measure of units, which takes into account varied package sizing. In order to incorporate the most current data available, sales were analyzed by each of the five 52-week periods from March 2, 2013 through February 24, 2018, and one 28-week period from February 24, 2018 to September 8, 2018. For simplicity, hereafter we refer to these time periods as 2013–2018.

Market share for each category is presented as a percentage, with the dollar (or unit) sales for that category divided by the total sales for the entire market. Additionally, a weighted mean nicotine concentration was calculated for each of the flavor, product type, and top brand categories. The weighted mean nicotine concentration in each category was calculated by using units sold as the weighting factor. Thus, the nicotine concentration for each product was multiplied by the number of units sold. The result was summed across all products in the category and then divided by the total number of units sold in that category. Changes over time in weighted mean nicotine concentration in products sold were tested using trend analyses. All analyses were completed using Stata SE 15.1.

3. Results

3.1. Total and unit sales

Total sales of e-cigarettes tracked by Nielsen grew 92.3%, from $746 million to $1,434 million, during 2013–2017; and increased 58.9% during 2016–2017 alone (Table 1). In 2018, total sales increased again to $1,719 million, an additional 20% increase for the 28-week period.

Unit sales increased 124.3% overall over the 5-year period, from 129.4 million units to 290.3 million units, and 43.0% during 2016–2017 alone (Table 2). The total number of individual products sold through Nielsen tracked channels increased from 699 in 2013 to 845 in 2018.

3.2. Nicotine concentration

During 2013–2017, weighted mean nicotine concentrations of products sold increased from 2.10% to 3.82% (Table 3). In 2018, mean nicotine concentration was 4.34%, an increase of 106.7% over 2013 and 13.6% over 2017. Trend analysis revealed a significant linear increase in nicotine concentration from 2013 to 2018 ($b = 0.414$, $SE = 0.041$, $p < 0.001$).

Higher-nicotine products accounted for increasing percentages of the Nielsen-tracked e-cigarette market across the study period when measured by both dollar (Table 1) and unit (Table 2) market share. In 2013, products with greater than 4% nicotine concentration represented 12.3% of dollar and 10.3% of unit market share; in 2017, these products accounted for 52.4% of dollar and 54.4% unit market share.

Much of the sales growth in higher nicotine products was due to products with nicotine concentrations of 5% or greater, which first entered the market in 2015. These products accounted for 31.8% of dollar sales in 2017 and 66.4% in 2018 (Fig. 1). Zero-nicotine products accounted for less than 1% of dollar market share across all years analyzed.

3.3. Flavors

Tobacco and menthol/mint flavors comprised the majority of the market during 2013–2017, with each accounting for approximately 30–40% of sales each year (Table 1). However, in 2018 market share for tobacco flavored products decreased by about half, from 29.5% in 2017 to 14.3% in 2018; during the same period, fruit flavored product market share nearly doubled, from 14.6% of dollar sales in 2017 to27.7% in 2018.

Tobacco, menthol/mint, fruit and the “other flavor” products all increased in nicotine concentration during 2013–2017 and again in 2018 (Table 3). Menthol/mint, fruit and “other flavors” each had weighted mean nicotine concentrations of over 4% in 2018. The weighted mean nicotine concentration for candy/sweet and beverages peaked in 2016 and 2017, respectively, before slightly declining in 2018.

3.4. Top brands

The top-selling e-cigarette brands changed considerably during the study period. The three brands with the largest market shares in 2013 were blu (43.0% dollar market share), NJOY (20.4%), and Logic (12.7%). In 2017, these three brands’ total dollar market share was reduced to 22.3%, and in 2018, their share was further reduced to9.7%. In 2017, the top-three brands by dollar market share were JUUL(31.7%), Vuse (27.7%), and MarkTen (14.0%). In 2018, the same three brands remained top sellers, though sales shifted further toward JUUL, which had 66.9%-dollar market share, while Vuse had 12.5%, and MarkTen had 7.7%. During 2017–2018, these top three brands, along with NJOY, sold products with higher concentrations of nicotine relative to other top brands (Table 3).

3.5. Product type

Sales of rechargeable/refill products increased during 2013–2017, as dollar market share shifted from disposables (56.9% dollar sales in 2013) to refillables (89.4% in 2017) (Table 1). In 2018, dollar share of rechargeable/refill products was 95.3%. Disposables’ weighted mean nicotine concentration remained constant over the study period (ranging from 2.3 to 2.7%); whereas mean nicotine concentration among rechargeable/refill products increased from 1.7% in 2013 to 3.9% in 2017, and then to 4.4% in 2018 (Table 3).

4. Discussion

This study reveals that the e-cigarettes sold in U.S. convenience stores and mass merchandisers contained, on average, significantly higher nicotine concentrations in 2018 than in 2013. Overall unit sales of e-cigarette products in the assessed channels more than doubled over this period, increasing by more than 40% during 2016–2017 alone. Furthermore, weighted average nicotine concentrations in e-cigarette products increased by more than 80% and all flavor categories increased in average nicotine concentration. During

the 28-week period ending September 2018, two-thirds of all e-cigarette dollar sales were for products containing 5–6% nicotine concentrations, even though no products with these nicotine concentrations were being sold through these channels prior to 2015.

These findings have important implications for the public's health (Soneji et al., 2018). The impact could be positive for adult smokers if changes in nicotine concentrations and/or speed of nicotine delivery increase the products' potential to serve as a complete substitute for all combustible forms of tobacco among adults (HHS et al., 2014). There is moderate evidence from randomized controlled trials that e-cigarettes with nicotine are more effective than e-cigarettes without nicotine for smoking cessation (NASEM, 2018). Additionally, a recent randomized trial conducted in the United Kingdom found that adult combustible cigarette smokers had higher abstinence from combustible cigarettes after 52 weeks when they used an e-cigarette in conjunction with behavioral therapy (18.0%) than when they used nicotine replacement therapy and behavioral therapy (9.9%) (Hajek et al., 2019). The study supplied e-cigarette starter kits with 1.8% nicotine, though participants were free to change devices or choose their own e-liquid refills up to 2% nicotine during the study period (Hajeck, 2019; European Commission, 2014). It is unknown how the concentration of nicotine in the e-cigarettes may have affected trial outcomes; however, it is noteworthy that 80% of those in the e-cigarette group that were abstinent from cigarettes were still using e-cigarettes at follow-up. Nevertheless, while certain types of e-cigarettes may show some promise in reducing health risks for individual adult smokers if used as a complete substitute for all combusted tobacco products, (Levy, 2017) scientific evidence on the effectiveness of e-cigarettes for smoking cessation is not conclusive (NASEM, 2018). Moreover, the majority of adult e-cigarette users also smoke cigarettes, and therefore continue to face serious health consequences caused by continued smoking (Schoenborn and Gindi, 2016).

In contrast, the public health impact of these products could also be negative. When examining e-cigarette use patterns among both current cigarette smokers and never smokers in 2014, one model estimated that e-cigarette use could lead to 1,510,000 years of life lost due primarily to initiation and eventual daily use of combustible cigarettes among never smoking youth who use e-cigarettes (Soneji et al., 2018). There are also potential concerns for young people; nicotine exposure during adolescence can cause addiction and can harm the developing adolescent brain, adversely impacting learning, memory, and attention (HHS et al., 2016). Given that an estimated 3 million high school students (20.8%) were past 30-day e-cigarette users in 2018, the observed increase in e-cigarette nicotine concentration is of particular public health concern (Cullen et al., 2018).

The marked increase in the average nicotine concentrations in e-cigarettes sold reflects, in part, shifts in the sales of certain types and brands during 2013–2018. Specifically, nearly all assessed e-cigarette sales in 2018 were rechargeable/refillable, as opposed to the disposable devices that made up the majority of sales in 2013. The three top-selling brands in 2018 (JUUL, Vuse and MarkTen) all sold rechargeable/refillable products that contained higher concentrations of nicotine than most other brands assessed. JUUL, which experienced considerable increases in sales during the study period and currently holds the largest share of the U.S. e-cigarette market, exclusively sold 5% nicotine strength products until August 21st, 2018, when the company offered 3% products in Mint and Tobacco flavors

(JUUL.com, 2018b). JUUL also contains nicotine salts, which allow for high nicotine levels to be rapidly inhaled and absorbed into the bloodstream, with less irritation, relative to the freebase nicotine that has traditionally been used in other e-cigarettes and tobacco products (Bowen and Xing, 2014). While this innovation may enhance the efficiency of nicotine delivery and could potentially increase the likelihood that adult smokers are able to transition completely from conventional cigarettes, JUUL's appealing flavors, coupled with the speed and efficiency with which it is able to deliver nicotine to the user, may increase the potential for initiation and dependence among young people. This is further illustrated by the fact that JUUL is commonly used among young people in the U.S., including in schools; nearly 1 in 5 middle and high school students reported seeing a JUUL used in school in April 2018 (Truth Initiative, 2018a). In 2018, 9.5% of 15–17-year-olds and 11.2% of 18–21-year-olds reported having ever used a JUUL, and 6.1% and 7.7% of these age groups, respectively, reported past-30 day use (Vallone et al., 2018). Estimates of current use are threefold higher for these 15–17-year-olds than adults 18 and older; in 2018, 2.0% of U.S. adults reported current use of USB flash drive shaped e-cigarettes, including JUUL (Marynak et al., 2019).

These data do not convey purchaser age. However, it is likely that many of these sales reflect products either obtained directly or indirectly by youth, given the high rates of youth usage and that nearly three-quarters of youth who have ever used JUUL report obtaining the device from a physical retail location, such as convenience stores (Truth Initiative, 2018b). Young people may have low awareness of the addictive potential of these products, including whether they contain nicotine. For example, among 15–24-year-olds who reported past-30 day use of JUUL, 63% did not understand that the product always contains nicotine (Willett et al., 2019). In a nationally representative survey from 2017, 12% of 8th graders, 19% of 10th graders, and 21% of 12th graders reported using e-cigarettes to deliver "flavoring only," (Johnston et al., 2018) yet 98.7% of flavored e-cigarettes sold in U.S. convenience and mass retailers contain nicotine in addition to flavoring (Marynak et al., 2017a).

The present study's findings reinforce the importance of efforts to prevent youth access to e-cigarettes. For example, in 2018, FDA announced efforts to increase enforcement of existing restrictions on sales of e-cigarettes to minors, including by curbing sales on third-party websites such as eBay and conducting additional compliance checks of tobacco retailers, as well as increased investment in youth e-cigarette prevention media campaigns (Food and Drug Administration [FDA], 2018). Additionally, U.S. states and localities are exercising their broad authority to adopt additional or more stringent requirements regarding tobacco product use; sales, including restrictions on sales of flavored tobacco products; marketing; and prices (Centers for Disease Control and Prevention, 2019; American Nonsmokers' Rights Foundation, 2018; Marynak et al., 2017b).

This study is subject to limitations. First, these data do not include sales through non-tracked channels, such as the Internet, tobacco specialty stores, and vape shops, where a substantial portion of e-cigarettes are sold, including most mods, tanks, or personal vaporizers (Wang et al., 2018). Second, the study could not assess purchaser age; thus, these sales could reflect purchases from adults or youth. Third, nicotine concentration was not reported by Nielsen for approximately one-quarter of unique e-cigarette products in the dataset; however,

Internet searches reduced the extent of missing data to 12% of all products, thus reducing the potential for bias. Fourth, sales data for Hawaii and Alaska are not available from Nielsen; therefore, the data only represent sales from the 48 contiguous states. Finally, the concentration of nicotine in the product does not necessarily reflect the concentration of nicotine absorbed by the user, which is dependent on many factors (Hajek et al., 2017; Goniewicz et al., 2018).

5. Conclusions

This study found that higher nicotine e-cigarette products account for a large and increasing share of U.S. e-cigarette sales. Public health implications of these changes could be positive for adult smokers seeking complete substitutes for combusted tobacco products, but negative for youth and young adults for whom nicotine exposure can cause adverse consequences for brain development and place them at risk for addiction. As the e-cigarette marketplace in the U.S. continues to evolve, further research will be important on sales and use of these products, especially with regard to nicotine concentration (HHS et al., 2016).

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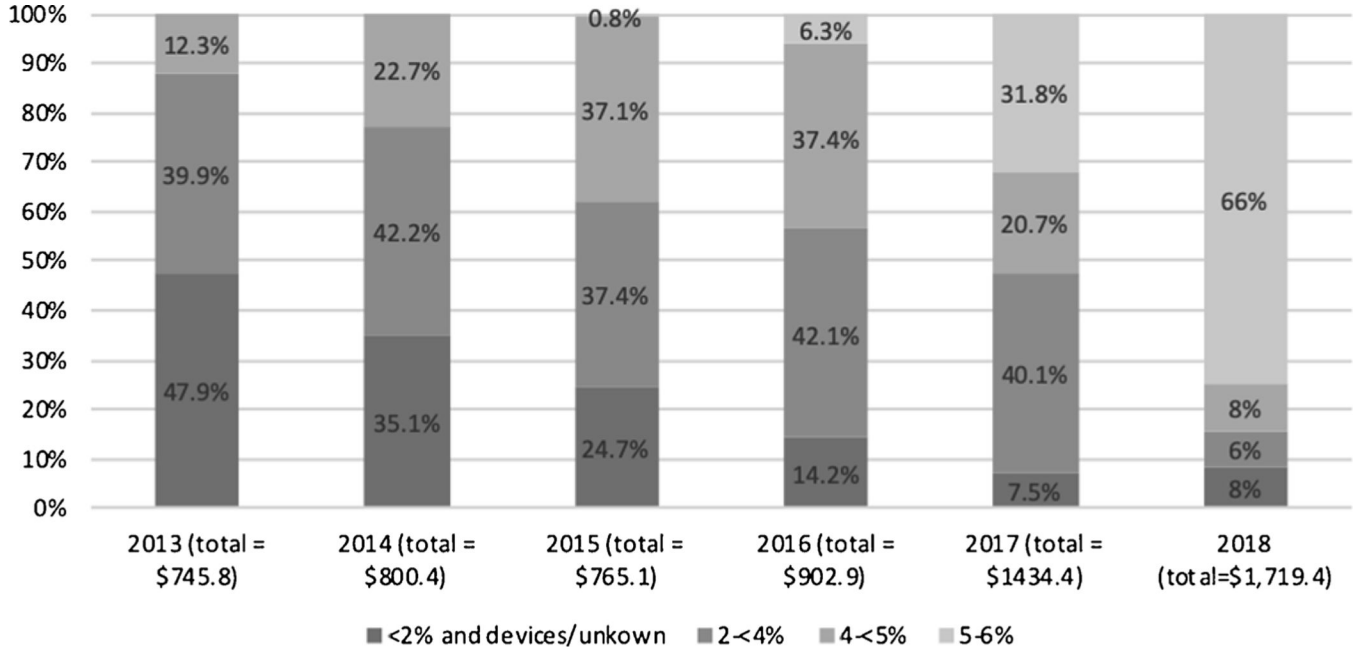

Fig. 1.
Proportion of total e-cigarette market (dollars) by nicotine concentration category.

Table 1

Proportion of dollar sales of e-cigarettes sold in the U.S. from 2013 to 2018, by nicotine concentration, flavor, product type, and top brands.

	2013 (52 weeks)	2014 (52 weeks)	2015 (52 weeks)	2016 (52 weeks)	2017 (52 weeks)	2018 (28 weeks)
	Dollars/ % Dollar market share	Dollars/ % Dollar market share	Dollars/ % Dollar market share	Dollars/ % Dollar market share	Dollars/ % Dollar market share	Dollars/ % Dollar market share
Total (in millions)	$745.80	$800.40	$765.10	$902.90	$1,434.40	$1,719.44
Nicotine concentration						
0%	0.3%	0.3%	0.2%	0.1%	0.0%	0.0%
< 1%	1.5%	1.1%	0.4%	0.4%	0.5%	0.3%
1 to < 2%	40.0%	27.0%	18.7%	11.4%	5.8%	6.1%
2 to < 3%	34.2%	35.5%	35.4%	33.7%	26.6%	12.7%
3 to < 4%	5.6%	6.7%	2.0%	8.4%	13.5%	4.7%
4 to < 5%	12.3%	22.7%	37.1%	37.4%	20.7%	8.3%
5 to 6%	0.0%	0.0%	0.8%	6.3%	31.8%	66.4%
Devices / Missing	6.0%	6.7%	5.4%	2.3%	1.1%	1.5%
Flavor						
Tobacco	37.4%	39.9%	40.9%	35.6%	29.5%	14.3%
Menthol/Mint	34.0%	33.3%	33.8%	35.6%	33.7%	33.9%
Fruit	3.4%	6.8%	9.6%	10.8%	14.6%	27.7%
Candy/Sweet	1.4%	1.6%	3.3%	6.9%	7.9%	5.3%
Beverages	0.6%	0.7%	1.2%	1.6%	0.6%	0.2%
Other Flavors	6.4%	3.2%	2.0%	2.5%	7.4%	11.3%
Devices / Not stated	16.8%	14.6%	9.2%	7.0%	6.3%	7.8%
Product Type						
Disposable	56.9%	34.3%	22.7%	16.6%	10.6%	4.7%
Rechargeable/Refill	43.1%	65.7%	77.3%	83.4%	89.4%	95.3%
Brand						
JUUL	-	-	0.8%	6.3%	31.7%	66.9%
Vuse	0.6%	18.8%	35.2%	36.8%	27.7%	12.5%
MarkTen	0.4%	8.2%	7.1%	14.2%	14.0%	7.7%
blu	43.0%	28.5%	22.1%	17.9%	12.0%	4.9%
Logic	12.7%	15.8%	14.0%	12.1%	8.2%	3.5%

	2013 (52 weeks)	2014 (52 weeks)	2015 (52 weeks)	2016 (52 weeks)	2017 (52 weeks)	2018 (28 weeks)
	Dollars/ % Dollar market share	Dollars/ % Dollar market share	Dollars/ % Dollar market share	Dollars/ % Dollar market share	Dollars/ % Dollar market share	Dollars/ % Dollar market share
NJOY	20.4%	7.2%	4.7%	3.6%	2.1%	1.3%
21 st Century Smoke	4.8%	2.5%	1.8%	1.2%	0.7%	0.2%
Finiti/Fin	5.0%	2.9%	1.7%	0.9%	0.2%	0.0%
All others	13.2%	16.1%	12.6%	7.0%	3.6%	3.1%

Table 2

Proportion of unit sales of e-cigarettes sold in the U.S. from 2013–2018, by nicotine concentration, flavor, product type, and top brands.

	2013 Units/ % Unit Share	2014 Units/ % Unit Share	2015 Units/ % Unit Share	2016 Units/ % Unit Share	2017 Units/ % Unit Share	2018 Units/ % Unit Share
Total (in millions)	129.4	157.0	173.4	203.0	290.3	365.3
Nicotine concentration						
0%	1.0%	0.4%	0.3%	0.1%	0.0%	0.0%
0– < 1%	1.4%	1.1%	0.4%	0.2%	0.2%	0.2%
1– < 2%	54.1%	33.9%	21.1%	12.5%	6.6%	6.9%
2– < 3%	25.8%	28.0%	27.7%	28.1%	22.4%	11.4%
3– < 4%	4.4%	6.3%	2.1%	10.1%	15.8%	4.9%
4– < 5%	10.3%	26.5%	45.2%	42.3%	23.9%	9.0%
5–6%	0.0%	0.0%	0.7%	5.8%	30.5%	67.2%
Devices / Missing	3.0%	3.7%	2.6%	1.1%	0.5%	0.4%
Flavor						
Tobacco	36.8%	40.6%	41.6%	33.4%	27.0%	14.2%
Menthol/Mint	35.3%	36.2%	37.8%	38.8%	37.6%	37.6%
Fruit	5.1%	5.5%	6.9%	9.4%	15.9%	30.7%
Candy/Sweet	2.5%	2.2%	3.7%	7.4%	8.5%	5.7%
Beverages	0.8%	0.6%	1.3%	1.8%	0.7%	0.3%
Other Flavors	3.1%	2.9%	1.7%	1.7%	3.9%	7.0%
Devices / Not Stated	16.4%	12.0%	6.9%	7.6%	6.4%	5.0%
Product Type						
Disposable	40.0%	21.2%	12.0%	9.4%	6.8%	2.9%
Rechargeable	60.0%	78.8%	88.0%	90.6%	93.2%	97.1%
Brand						
JUUL	-	-	0.7%	5.8%	30.4%	67.2%
Vuse	0.8%	23.1%	43.6%	41.6%	29.6%	13.5%
MarkTen	0.4%	8.0%	7.7%	17.0%	17.3%	8.3%
Blu	36.1%	21.8%	13.4%	11.5%	8.6%	3.2%
Logic	13.1%	15.9%	14.3%	11.7%	7.4%	3.9%
NJOY	17.2%	5.5%	3.2%	2.7%	1.6%	1.0%
21 st Century Smoke	7.5%	4.3%	2.9%	2.1%	1.3%	0.4%
Finiti/Fin	6.0%	4.2%	2.3%	1.0%	0.2%	0.0%
All others	19.0%	17.1%	11.9%	6.7%	3.6%	2.6%

Table 3

Weighted mean nicotine concentration of products sold in Nielsen-tracked xAOC and Convenience outlets from 2013 to 2018, by flavor, product type, and brand.

	2013	2014	2015	2016	2017	2018
Total	2.1%	2.8%	3.4%	3.6%	3.8%	4.3%
Flavor						
Tobacco	1.9%	2.9%	3.5%	3.5%	3.6%	3.6%
Menthol/Mint	2.2%	2.9%	3.5%	3.7%	4.0%	4.4%
Fruit	1.4%	1.6%	2.7%	3.5%	4.1%	4.7%
Candy/Sweet	1.5%	1.6%	3.5%	4.1%	4.0%	3.8%
Beverages	1.2%	1.5%	4.0%	4.6%	4.6%	3.5%
Other Flavors	1.6%	1.7%	2.1%	3.2%	4.2%	4.5%
Not stated	3.0%	3.0%	2.7%	2.4%	2.6%	3.7%
Product Type						
Disposable	2.7%	2.4%	2.3%	2.4%	2.5%	2.7%
Rechargeable/Refill	1.7%	2.9%	3.3%	3.7%	3.9%	4.4%
Brand						
JUUL	-	-	5.0%	5.0%	5.0%	5.0%
Vuse	4.8%	4.8%	4.8%	4.7%	4.2%	3.4%
MarkTen	3.5%	3.1%	2.7%	3.0%	3.1%	3.1%
blu	1.7%	1.7%	2.1%	2.2%	2.2%	2.2%
Logic	2.1%	2.2%	2.1%	2.1%	2.2%	2.4%
NJOY	3.6%	3.7%	3.2%	3.6%	4.0%	4.0%
21 st century smoke	1.6%	1.7%	1.7%	1.7%	1.7%	1.7%
Finiti/fin	1.7%	1.8%	1.9%	2.0%	1.9%	1.7%
All others	1.7%	1.9%	1.9%	1.8%	1.8%	2.2%