



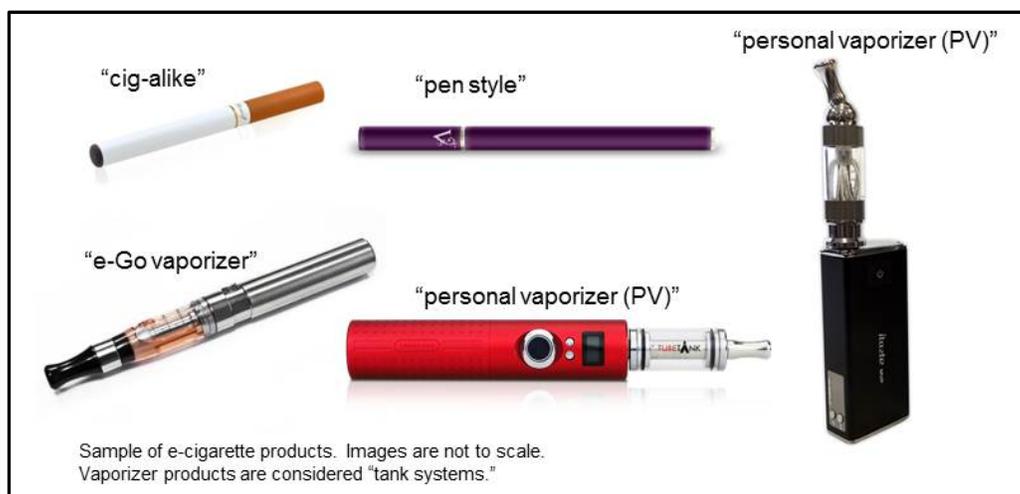
ELECTRONIC CIGARETTES: AN OVERVIEW OF KEY ISSUES

A significant number of adults and youth are using electronic cigarettes, which provide a relatively new way to deliver the addictive substance nicotine without burning tobacco. Many questions remain about the long-term health effects of these products for individual users and about the population-wide effects of these products. It is not clear whether these products will help people quit, discourage smokers from quitting completely, or lead to nicotine addiction and tobacco use for new users, including kids. A 2016 report of the Surgeon General noted that gaps in scientific evidence do exist, and the products themselves as well as the patterns of use are changing quickly.¹ However, the Surgeon General also found that “e-cigarette use among U.S. youth and young adults is now a major public health concern.” The Surgeon General noted that while we continue to learn more about e-cigarettes, “we currently know enough to take action to protect our nation’s young people from being harmed by these products.”

What are Electronic Cigarettes?

The term “electronic cigarettes” covers a wide variety of products now on the market, from those that look like cigarettes or pens to somewhat larger products like “personal vaporizers” and “tank systems.” Instead of burning tobacco, e-cigarettes most often use a battery-powered coil to turn a liquid solution into an aerosol that is inhaled by the user. There are a wide range of reusable e-cigarettes, which enable users to replace a nicotine-containing cartridge or refill a tank with a liquid solution, and there are disposable e-cigarettes, which cannot be refilled. Also growing in popularity are “mods,” which are units that users assemble themselves from separate component parts, to allow variation in battery power, style, and size.² A study analyzing brand growth from 2012 to 2014 found that newer e-cigarette brands were more likely to offer tank-style and “mod” devices as opposed to cig-alikes.³ A 2014 study found more than 460 brands of e-cigarettes available for purchase online, with the number increasing by an average of more than ten brands per month.⁴

The liquid solution used in e-cigarettes typically contains nicotine, propylene glycol, glycerin or some other solvent, and other additives. E-cigarettes and refill liquids or cartridges often contain flavorings, including fruit and candy flavorings that are not permitted in regular cigarettes. Many e-cigarettes and their refill liquids also come in sweet flavors, such as chocolate, gummi bear, chocolate chip cookies, and strawberry, which have long been considered attractive to kids. By January 2014, researchers were able to identify more than 7,700 unique e-cigarette flavors available online, with an average of more than 240 new flavors being added per month.⁵ In addition to the vast selection available online, thousands of “vape” shops have now opened throughout the country that allow consumers to sample and purchase refill liquids, including a combination of flavors chosen by the user and in varying levels of nicotine.



* For the purposes of this factsheet, the term “e-cigarettes” will be used to represent the entire category of products.

Sales of e-cigarettes were projected to reach \$3.5 billion in the U.S. in 2015.⁶ While the e-cigarette market was originally dominated by companies whose primary product was e-cigarettes, the three major U.S. tobacco companies – Altria/Philip Morris, Reynolds American/Lorillard and ITG Brands – have now entered the e-cigarette market. There are, however, hundreds of e-cigarette companies and thousands of “vape” shops in the U.S. market, leading to a wide variety of product characteristics, including ingredients and nicotine content. A large proportion of e-cigarettes in the U.S. market are imported. Globally, more than 95 percent of e-cigarettes are estimated to be manufactured in China.⁷ For those that are domestically produced or assembled, certain components and ingredients are still manufactured abroad.⁸

E-Cigarette Marketing

The 2016 Surgeon General report stated that, “E-cigarettes are marketed by promoting flavors and using a wide variety of media channels and approaches that have been used in the past for marketing conventional tobacco products to youth and young adults.”⁹ An investigative report released in April 2014 by 11 members of Congress¹⁰ provides some of the most detailed evidence to date that e-cigarette manufacturers have resurrected the marketing practices used by tobacco companies for decades to attract kids to smoking. These tactics include ads that reach youth audiences; sponsorships and free samples at youth-oriented events such as auto races and music festivals; celebrity spokespersons who depict e-cigarette smoking as glamorous; and sweet, kid-friendly flavors with names like Cherry Crush, Chocolate Treat, Cotton Candy and Gummy Bear. The report finds that many of the e-cigarette companies also use social media to promote their products.

Unlike cigarette and smokeless tobacco companies, e-cigarette companies are not currently required to report their marketing and promotional expenditures to the U.S. Federal Trade Commission (FTC), so the exact amount spent to advertise and promote these products is uncertain. However, e-cigarette marketing expenditures are estimated to have increased dramatically in recent years, from \$12 million in 2011 to \$125 million in 2014.¹¹ Other studies have also documented this significant increase in spending.¹² These figures likely underestimate the true extent of e-cigarette advertising, as the available marketing data is not comprehensive (e.g., social media and sponsored events—strategies widely used by numerous e-cigarette companies—are not included). Additionally, the nationwide rollout of the Vuse and MarkTen brands did not occur until mid-2014, so the full impact of these brands on e-cigarette marketing expenditures is unknown.

These advertising efforts have effectively reached youth and young adults. The Surgeon General concluded that, “E-cigarettes are marketed in a wide variety of channels that have broad reach among youth and young adults.”¹³ The 2014 National Youth Tobacco Survey (NYTS) found that 68.9 percent of middle and high school students—18.3 million youth—had been exposed to e-cigarette advertisements from at least one source.¹⁴ Another recent study found that 82 percent of 12-17 year olds and 88 percent of 18-21 year olds reported seeing e-cigarette advertising in 2015.¹⁵ A 2016 study in *Pediatrics*, analyzing 2014 YTS data, found that exposure to e-cigarette advertising is associated with current e-cigarette use among youth and that greater exposure to e-cigarette advertising is associated with higher odds of use.¹⁶

Use of E-Cigarettes Among Adults and Youth

E-cigarette use among youth exceeds the use of cigarettes and other tobacco products. While the most recent data indicate that e-cigarette use among youth may have peaked, the number of youth using e-cigarettes is alarming and raises serious concerns. While it is still an open scientific question whether e-cigarettes might be able to help adult smokers give up cigarettes, kids should not be using any tobacco product, including e-cigarettes.

Youth Use. Data from the National Youth Tobacco Survey (NYTS), released by the U.S. Centers for Disease Control and Prevention (CDC) and the Food and Drug Administration (FDA), show that youth use of electronic cigarettes declined for the first time in 2016.¹⁷ This finding is consistent with other national data from the Monitoring the Future survey which found a significant decline in vaping from 2015 to 2016 among 8th, 10th, and 12th graders.¹⁸ However, both surveys found that that e-cigarette use continues to exceed use of cigarettes and other tobacco products.

According to the NYTS, 11.3 percent of high schoolers and 4.3 percent of middle schoolers reported current use of e-cigarettes in 2016.¹⁹ E-cigarette use among high school students declined significantly from 2015 to 2016, the first decline in youth e-cigarette use after it had increased ten-fold from 2011 to 2015 (it was just 1.5% in 2011).²⁰ Current use is defined as use on at least one day in the past 30 days. Over 2.3 million high school students and 620,000 middle school students currently use e-cigarettes. According to the NYTS, over 1.6 million high school students and 500,000 middle school students currently use e-cigarettes. Since the survey also found that over 1.4 million youth smoke cigarettes, this means that at least 750,000 current e-cigarette users do not smoke cigarettes.²¹

Among those students who had used e-cigarettes in the past 30 days in 2014, 15.5 percent of high schoolers and 11.8 percent of middle schoolers were frequent users of e-cigarettes, using e-cigarettes on at least 20 of the preceding 30 days. This amounts to an estimated 340,000 middle and high school students who were frequent users of e-cigarettes. More than a quarter of high school e-cigarette users had used e-cigarettes on at least ten days in the previous month.²²

Multiple national surveys show that flavored e-cigarettes are popular among youth. Data from FDA's 2013-2014 Population Assessment of Tobacco and Health (PATH) survey found that 81 percent of youth aged 12-17 who had ever used e-cigarettes had used a flavored e-cigarette the first time they tried the product, and that 85.3 percent of current youth e-cigarette users had used a flavored e-cigarette in the past month. Moreover, 81.5 percent of current youth e-cigarette users said they used e-cigarettes "because they come in flavors I like."²³ While the methodology is not comparable to the PATH study, an analysis of the 2015 NYTS found that 44.6 percent of middle and high school e-cigarette users—totaling 1.26 million youth—had used a flavored e-cigarette in the past month.²⁴

Adult Use. Data from the National Health Interview Survey (NHIS) show that in 2016, 3.2 percent of adults currently used e-cigarettes every day or some days (it was 3.5 percent in 2015) and 15.4 percent of adults had ever tried an e-cigarette.²⁵

E-cigarette use is higher among younger adult populations. According to the 2016 NHIS, 23.5 percent of 18-24 year olds had ever tried an e-cigarette and 4.5% currently use e-cigarettes every day or some days.²⁶ Earlier data from the 2015 NHIS showed that 40 percent of young adult e-cigarette users had never been cigarette smokers, raising concerns that e-cigarettes may be attracting young non-smokers to tobacco use.²⁷

Health and Public Health Concerns

Under the right circumstances, e-cigarettes could benefit public health if they help significantly reduce the number of people who use conventional cigarettes and die of tobacco-related disease. However, many questions remain about the potential risks to public health posed by these products.

E-cigarette ingredients and constituents. There is insufficient research on the long-term effects of using e-cigarettes, which involves regular inhalation of nicotine, glycerin or some other solvent, and other additives.²⁸ According to the Surgeon General, "E-cigarette aerosol is not harmless. It can contain harmful and potentially harmful constituents, including nicotine."²⁹ The nicotine present in e-cigarette aerosol is absorbed by users and bystanders.³⁰ Studies have found other chemicals and toxins present in some e-cigarettes, including formaldehyde, acrolein, volatile organic compounds like toluene, tobacco-specific nitrosamines, and metals like nickel and lead.³¹ These compounds are generally present at levels much lower than in cigarette smoke, although the compounds themselves are found on FDA's list of harmful or potentially harmful substances.³² Because FDA has just begun to regulate e-cigarettes, which are available in hundreds of different brands³³, there is no way for consumers to know for sure yet what is in the products or the aerosol.³⁴

In addition, while some of the other substances, such as flavorings, used in e-cigarettes might be labeled as "generally recognized as safe," some researchers as well as the organization primarily responsible for granting that designation³⁵ have noted that it applies to ingestion, not for other exposures such as inhalation. In its 2016 report, the Surgeon General stated that, "while some of the flavorings used in e-cigarettes are generally recognized as safe for ingestion as food, the health effects of their inhalation are generally unknown" and noted that some of the flavorings found in e-cigarettes have been shown to cause

serious lung disease when inhaled.³⁶ An article in the *Journal of the American Medical Association* raised concerns that the chemical flavorings found in some e-cigarettes and e-liquids could cause respiratory damage when the e-cigarette aerosol is inhaled deeply into the lungs.³⁷

Impact of Nicotine. E-cigarettes and refill liquids contain widely varying levels of nicotine. While e-cigarettes can be used for non-nicotine products, including marijuana, more than two-thirds of youth e-cigarette users report using e-cigarettes exclusively for nicotine-containing products.³⁸ Nicotine is a highly addictive drug that can have lasting damaging effects on adolescent brain development and has been linked to a variety of adverse health outcomes for the developing fetus.³⁹ Nicotine also impacts the cardiovascular system.⁴⁰ The Surgeon General concluded that, “The use of products containing nicotine poses dangers to youth, pregnant women, and fetuses. The use of products containing nicotine in any form among youth, including in e-cigarettes, is unsafe.”⁴¹

There is also concern that nicotine exposure from use of e-cigarettes may function as an entryway to use of more dangerous, combustible tobacco products. The Surgeon General found that while more research is needed, e-cigarette use is “strongly associated” with the use of other tobacco products among youth and young adults, including conventional cigarettes.⁴²

Poisoning and Exposure to Liquid Nicotine. Delivered in high doses, nicotine can be lethal. The Surgeon General found that, “Ingestion of e-cigarette liquids containing nicotine can cause acute toxicity and possibly death if the contents of refill cartridges or bottles containing nicotine are consumed.”⁴³ Exposure to liquid nicotine found in e-cigarettes has resulted in thousands of calls to poison control centers in recent years, peaking in 2014, according to the American Association of Poison Control Centers (AAPCC).⁴⁴ In 2014, more than half of these calls to poison hotlines were to report exposures among children under the age of six.⁴⁵ To begin to address the poisoning risk that e-cigarettes and liquid nicotine pose to young children, in 2016 Congress passed the Child Nicotine Poisoning Prevention Act, which gave the Consumer Product Safety Commission authority to enforce child resistant packaging standards for e-cigarette products. This law went into effect in July 2016.

Number of calls to poison control centers involving exposures to e-cigarette devices and liquid nicotine.

2011	271
2012	460
2013	1,543
2014*	4,024
2015*	3,744
2016*	2,886
Through Sept. 2017*	1,797

* Preliminary data, as poison centers continue to update their reports.

Dual Use and Cessation. Data show that the large majority of e-cigarette users (both adults and youth) report using both e-cigarettes and conventional cigarettes, raising additional concerns beyond the potential health effects of e-cigarettes alone.

The currently available data indicate that most e-cigarette users report using both e-cigarettes and cigarettes. A 2015 survey found that the majority of current e-cigarette users (58.8 percent) were also current smokers.⁴⁶ Earlier data from 2014 found that nearly half (47.6 percent) of current smokers reported having ever tried e-cigarettes, with 15.9 percent of smokers reporting that they also currently use e-cigarettes.⁴⁷ The same survey found that 20.3 percent of smokers who had tried to quit smoking in the past year and 22 percent of recent former cigarette smokers (those who quit smoking within the past year) currently used e-cigarettes.

This high level of dual use is not surprising given that e-cigarette marketing urges smokers to use e-cigarettes at times and in places where they cannot smoke conventional cigarettes. This type of marketing encourages this dual use of electronic and conventional cigarettes, thus promoting continued smoking. One study found that more than 80 percent of e-cigarette users pointed to use in smoke-free zones as a reason for using the product.⁴⁸

Some e-cigarette users report that they believe that e-cigarettes will help them quit or reduce the number of cigarettes they smoke.⁴⁹ However, there is not enough evidence to conclude whether e-cigarettes are a safe and effective smoking cessation device.⁵⁰ The U.S. Preventive Services Task Force, which makes recommendations about the effectiveness of specific preventive care services after a thorough assessment of the science, recently concluded that “the current evidence is insufficient to recommend electronic nicotine

delivery systems for tobacco cessation...⁵¹ According to researchers from the CDC, “There is currently no conclusive scientific evidence that e-cigarettes promote long-term cessation, and e-cigarettes are not included as a recommended smoking cessation method by the U.S. Public Health Service.”⁵²

Existing research is limited and provides mixed results about the effectiveness of e-cigarettes in helping current smokers successfully quit. Two randomized controlled trials found that e-cigarettes are moderately effective in helping smokers quit, with rates of cessation with e-cigarettes similar to rates of cessation with NRT.⁵³ A 2014 longitudinal study of current smokers found that smokers who used e-cigarettes daily for at least one month were more than six times as likely to have quit smoking than those who never used e-cigarettes or only used them once or twice.⁵⁴ Other studies have found that e-cigarette use is not associated with successful quitting, finding that e-cigarette users were not more likely to have quit smoking compared to non-users.⁵⁵ Nationally representative cross-sectional studies have found an association between frequency of e-cigarette use and cessation behavior. One study found that daily e-cigarette users were significantly more likely than non-e-cigarette users to be former cigarette smokers and that smoking cessation was highest among daily e-cigarette users compared to any other demographic or behavioral subgroup.⁵⁶ Additional research shows that smokers who use e-cigarettes more frequently are more likely to have made a quit attempt than smokers who don't use e-cigarettes.⁵⁷

A study of current and former cigarette smokers found that e-cigarette users significantly reduced the number of cigarettes smoked per day compared to non-users, although at follow-up, e-cigarette users were not more likely to have quit smoking compared to non-users.⁵⁸ Reducing the number of cigarettes smoked is a good thing if it eventually leads to quitting completely. However, e-cigarettes could ultimately reduce the number of smokers who would otherwise quit if smokers continue to use them in addition to, and not instead of, regular cigarettes. This would have a negative impact on public health. Smokers who continue to smoke (even fewer cigarettes per day) but also use e-cigarettes will increase their individual risk if this delays or prevents cessation. Furthermore, CDC has highlighted the importance of quitting cigarettes completely, not just cutting down. According to the CDC, “If you only cut down the number of cigarettes you smoke by adding another tobacco product, like e-cigarettes, you still face serious health risks. Smokers must quit smoking completely to fully protect their health – even a few cigarettes a day are dangerous.”⁵⁹

Compared to non-smokers, light and intermittent smokers are at greater risk for cardiovascular diseases, lung cancer and lower respiratory tract infections, among other things.⁶⁰ One study found that smoking just 1-4 cigarettes a day doubles the risk of dying from heart diseases.⁶¹ Several Surgeon General's Reports and other studies have indicated that the risk of cardiovascular disease and other smoking-related diseases depends largely on the length of time a person smokes, not just the number of cigarettes smoked. Thus, prolonging smoking, despite smoking fewer cigarettes from using e-cigarettes, will continue to put that person's health at greater risk than if he or she had quit smoking entirely.⁶²

Important unanswered questions:

- *As discussed above, instead of replacing cigarettes completely, do e-cigarettes lead to dual use by cigarette smokers by providing a way to satisfy their nicotine addiction in places they cannot smoke?*
- *If e-cigarettes continue to be irresponsibly marketed, could they make smoking look glamorous again and undermine decades of work to reduce youth smoking?*
- *Do e-cigarettes serve as a gateway to nicotine addiction and use of other tobacco products for new users, including kids?*
- *Do e-cigarettes draw former smokers back into nicotine addiction and potentially back to cigarette smoking?*

There are many important unanswered questions regarding the short and long-term impact that e-cigarettes may have on public health. Effective regulation is needed to minimize the potential harms of e-cigarettes and maximize any potential benefits.

- ¹ US Department of Health and Human Services (HHS), *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: 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, 2016.
- ² Wells Fargo, *Vape Shops – Springing Up Across The Country*, April 14, 2014.
- ³ HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: 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, 2016. See also Zhu, S-H, et al., “Four Hundred and Sixty Brands of E-cigarettes and Counting: Implications for Product Regulation,” *Tobacco Control*, 23(Suppl 3):iii3-iii9, 2014, http://tobaccocontrol.bmj.com/content/23/suppl_3/iii3.full.
- ⁴ Zhu, S-H, et al., “Four Hundred and Sixty Brands of E-cigarettes and Counting: Implications for Product Regulation,” *Tobacco Control*, 23(Suppl 3):iii3-iii9, 2014, http://tobaccocontrol.bmj.com/content/23/suppl_3/iii3.full.
- ⁵ Zhu, S-H, et al., “Four Hundred and Sixty Brands of E-cigarettes and Counting: Implications for Product Regulation,” *Tobacco Control*, 23(Suppl 3):iii3-iii9, 2014, http://tobaccocontrol.bmj.com/content/23/suppl_3/iii3.full.
- ⁶ HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: 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, 2016. See also Rose, SW, et al., “The availability of electronic cigarettes in U.S. retail outlets, 2012: results of two national studies,” *Tobacco Control*, 23(Suppl 3): ii10-ii16, 2014.
- ⁷ HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: 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, 2016. See also Jourdan, A. “Vaping” a slow burner in China, world’s maker of e-cigarettes, 2014, <http://www.reuters.com/article/us-china-smoking/vaping-a-slow-burner-in-china-worlds-maker-of-e-cigarettes-idUSBREA0E1JX20140115> , accessed January 3, 2017.
- ⁸ Chang, H, “Research gaps related to the environmental impacts of electronic cigarettes,” *Tobacco Control* 23(Suppl 2):ii54-8, 2014, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3995274/pdf/tobaccocontrol-2013-051480.pdf>.
- ⁹ HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: 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, 2016.
- ¹⁰ “Gateway to Addiction? A Survey of Popular Electronic Cigarette Manufacturers and Marketing to Youth,” April 14, 2014, <http://democrats.energycommerce.house.gov/sites/default/files/documents/Report-E-Cigarettes-Youth-Marketing-Gateway-To-Addiction-2014-4-14.pdf>
- ¹¹ HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: 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, 2016.
- ¹² Kornfield, R, et al., “Rapidly increasing promotional expenditures for e-cigarettes,” *Tobacco Control*, Published Online First, doi: 10.1136/tobaccocontrol-2014-051580, April 30, 2014. See also: Dutra, L, *Adolescent E-cigarette Use: What We Already Know*. 2014 data from Kantar Media. Presentation at the FDA “Electronic Cigarettes and the Public Health: A Public Workshop,” June 1, 2015. Legacy, *Vaporized: E-Cigarettes, Advertising, and Youth*, April 2014, http://legacyforhealth.org/content/download/4542/63436/version/1/file/LEG-Vaporized-E-cig_Report-May2014.pdf. Truth Initiative, *Vaporized: Youth and Young Adult Exposure to E-Cigarette Marketing*, November 2015, <http://truthinitiative.org/sites/default/files/VAPORIZED%20-%20FINAL%20VERSION.pdf>.
- ¹³ HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: 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, 2016.
- ¹⁴ CDC, Vital Signs: Exposure to Electronic Cigarette Advertising Among Middle School and High School Students—United States, 2014,” *Morbidity and Mortality Weekly Report*, 64(52): 1403-1408, January 8, 2016.
- ¹⁵ Truth Initiative, *Vaporized: Youth and Young Adult Exposure to E-Cigarette Marketing*, November 2015, <http://truthinitiative.org/sites/default/files/VAPORIZED%20-%20FINAL%20VERSION.pdf>.
- ¹⁶ Singh, T, et al., “Exposure to Advertisements and Electronic Cigarette Use Among US Middle and High School Students,” *Pediatrics*, published online April 25, 2016.
- ¹⁷ U.S. Centers for Disease Control and Prevention (CDC), “Tobacco Use Among Middle and High School Students — United States, 2011-2016,” *Morbidity and Mortality Weekly Report (MMWR)* 66(23):597-603, June 16, 2017, <https://www.cdc.gov/mmwr/volumes/66/wr/pdfs/mm6623a1.pdf>.
- ¹⁸ University of Michigan, Monitoring the Future Study, “Trends in Annual and 30-Day Prevalence of Use of Other Tobacco Products for Grades 8, 10, and 12,” <http://www.monitoringthefuture.org/data/16data/16cigtbl1.pdf>.
- ¹⁹ CDC, “Tobacco Use Among Middle and High School Students — United States, 2011-2016,” *MMWR*, 66(23):597-603, June 16, 2017, <https://www.cdc.gov/mmwr/volumes/66/wr/pdfs/mm6623a1.pdf>.
- ²⁰ CDC “Tobacco Use Among Middle and High School Students — United States, 2011-2015,” *MMWR*, 65(14):361-367, April 14, 2016, <http://www.cdc.gov/mmwr/volumes/65/wr/pdfs/mm6514a1.pdf>.
- ²¹ U CDC, “Tobacco Use Among Middle and High School Students — United States, 2011-2016,” *MMWR*, 66(23):597-603, June 16, 2017, <https://www.cdc.gov/mmwr/volumes/66/wr/pdfs/mm6623a1.pdf>.
- ²² CDC, “Frequency of Tobacco Use Among Middle and High School Students — United States, 2014,” *MMWR* 64(38):1061-1065, October 2015, <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6438a1.htm>
- ²³ Ambrose, BK, et al., “Flavored Tobacco Product Use Among US Youth Aged 12-17 Years, 2013-2014,” *Journal of the American Medical Association*, published online October 26, 2015.

²⁴ HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: 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, 2016.

²⁵ CDC, "Quick Stats: Percentage of Adults Who Ever Used and E-Cigarette and Percentage Who Currently Use E-Cigarettes, by Age Group—National Health Interview Survey, United States, 2016," *Morbidity and Mortality Weekly Report*, 66(33): 892, <https://www.cdc.gov/mmwr/volumes/66/wr/pdfs/mm6633a6.pdf>.

²⁶ CDC, "Quick Stats: Percentage of Adults Who Ever Used and E-Cigarette and Percentage Who Currently Use E-Cigarettes, by Age Group—National Health Interview Survey, United States, 2016," *Morbidity and Mortality Weekly Report*, 66(33): 892, <https://www.cdc.gov/mmwr/volumes/66/wr/pdfs/mm6633a6.pdf>.

²⁷ CDC, "Quick Stats: Cigarette Smoking Status Among Current Adult E-Cigarette Users, by Age Group—National Health Interview Survey, United States, 2015," *Morbidity and Mortality Weekly Report*, 65(42): 1177, http://www.cdc.gov/mmwr/volumes/65/wr/mm6542a7.htm?s_cid=mm6542a7_w.

²⁸ CDC, "Dual Use of Tobacco Products." <http://www.cdc.gov/tobacco/campaign/tips/diseases/dual-tobacco-use.html#ten>. Accessed November 19, 2015.

²⁹ HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: 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, 2016.

³⁰ CDC, "Dual Use of Tobacco Products." <http://www.cdc.gov/tobacco/campaign/tips/diseases/dual-tobacco-use.html#ten>. Accessed November 19, 2015.

³¹ Cheng, T, "Chemical Evaluation of Electronic Cigarettes," *Tobacco Control* 23:ii11-ii17, May 2014.

http://tobaccocontrol.bmj.com/content/23/suppl_2/ii11.full. Goniewicz, ML, et al., "Levels of selected carcinogens and toxicants in vapour from electronic cigarettes," *Tobacco Control* 23(2):133-9, March 6, 2013. Williams, M, et al., "Metal and Silicate Particles Including Nanoparticles Are Present in Electronic Cigarette Cartomizer Fluid and Aerosol," *PlosOne*, 8(3), March 2013. See also Williams, M, "Electronic Cigarette Liquids and Vapors: Is It Harmless Water Vapor," presented October 3, 2013 at TRDRP Electronic Cigarette Webinar, <http://www.trdrp.org/docs/Williams%20ecig%20vapor%20this%20time%20slides%202013.pdf>.

³² Goniewicz, ML, et al., "Levels of selected carcinogens and toxicants in vapour from electronic cigarettes," *Tobacco Control* 23(2):133-9, March 6, 2013. Williams, M, et al., "Metal and Silicate Particles Including Nanoparticles Are Present in Electronic Cigarette Cartomizer Fluid and Aerosol," *PlosOne*, 8(3), March 2013. See also FDA, "Harmful and Potentially Harmful Constituents in Tobacco Products and Tobacco Smoke: Established List," March 2012, <http://www.fda.gov/TobaccoProducts/GuidanceComplianceRegulatoryInformation/ucm297786.htm>.

³³ Zhu, S-H, et al., "Four Hundred and Sixty Brands of E-cigarettes and Counting: Implications for Product Regulation," *Tobacco Control*, 23(Suppl 3):iii3-iii9, 2014, http://tobaccocontrol.bmj.com/content/23/suppl_3/iii3.full.

³⁴ CDC, "Dual Use of Tobacco Products." <http://www.cdc.gov/tobacco/campaign/tips/diseases/dual-tobacco-use.html#ten>. Accessed November 19, 2015.

³⁵ Flavor and Extract Manufacturers Association of the United States (FEMA), *The Safety Assessment and Regulatory Authority to Use Flavors – Focus on E-Cigarettes*, Revised March 3, 2015, <http://www.femaflavor.org/safety-assessment-and-regulatory-authority-use-flavors-focus-e-cigarettes>.

³⁶ HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: 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, 2016.

³⁷ Barrington-Trimis, JL, Samet, JM, & McConnell, R, "Flavorings in Electronic Cigarettes: An Unrecognized Respiratory Health Hazard?" *The Journal of the American Medical Association*, doi:10.1001/jama.2014.14830, published online November 10, 2014.

³⁸ CDC, "Characteristics of Electronic Cigarette Use Among Middle and High School Students—United States, 2015," *MMWR*, 65(50-51): 1425-1429, <https://www.cdc.gov/mmwr/volumes/65/wr/pdfs/mm655051a2.pdf>.

³⁹ U.S. Department of Health and Human Services (HHS), *The Health Consequences of Smoking: 50 Years of Progress. A Report of the Surgeon General*, CDC, Office of Smoking and Health (OSH), 2014, <http://www.surgeongeneral.gov/library/reports/50-years-of-progress/index.html>. See also: CDC Office on Smoking and Health, "Electronic Nicotine Delivery Systems: Key Facts," July 2015. Accessed November 19, 2015. <http://www.cdc.gov/tobacco/stateandcommunity/pdfs/ends-key-facts2015.pdf>

⁴⁰ HHS, *How Tobacco Smoke Causes Disease: The Biology and Behavioral Basis for Smoking-Attributable Disease: A Report of the Surgeon General*, Centers for Disease Control and Prevention, Office on Smoking and Health, 2010 <http://www.ncbi.nlm.nih.gov/books/NBK53017/>.

⁴¹ HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: 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, 2016.

⁴² HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: 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, 2016

⁴³ HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: 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, 2016.

⁴⁴ American Association of Poison Control Centers, "Electronic Cigarette and Liquid Nicotine," <http://www.aapcc.org/alerts/e-cigarettes/>.

⁴⁵ American Association of Poison Control Centers (AAPCC), E-Cigarette Devices and Liquid Nicotine, <http://www.aapcc.org/alerts/e-cigarettes/>, accessed July 13, 2016. Data from 2014-2016 are considered preliminary and the numbers may change as cases are closed and

additional information is received. See also: CDC, "Notes from the Field: Calls to Poison Centers for Exposures to Electronic Cigarettes — United States, September 2010–February 2014," *MMWR* 63(13):292-293, April 4, 2014, <http://www.cdc.gov/mmwr/pdf/wk/mm6313.pdf>.

⁴⁶ CDC, "Quick Stats: Cigarette Smoking Status Among Current Adult E-Cigarette Users, by Age Group—National Health Interview Survey, United States, 2015," *Morbidity and Mortality Weekly Report*, 65(42): 1177, http://www.cdc.gov/mmwr/volumes/65/wr/mm6542a7.htm?s_cid=mm6542a7_w.

⁴⁷ Schoenborn, CA & Gindi, RM, "Electronic Cigarette Use Among Adults: United States, 2014," National Center on Health Statistics (NCHS) Data Brief, No. 217, October 2015, <http://www.cdc.gov/nchs/data/databriefs/db217.htm>.

⁴⁸ Adkison, S., et al. "Electronic Nicotine Delivery Systems: International Tobacco Control Four-Country Survey," *Am J Prev Med*, 44(3):207-215, 2013.

⁴⁹ Grana, R, et al., "E-Cigarettes: A Scientific Review," *Circulation* 129(19):1972-86, 2014, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4018182/pdf/cir-129-1972.pdf>.

⁵⁰ King, BA, et al., "Awareness and Ever Use of Electronic Cigarettes Among U.S. Adults, 2010-2011," *Nicotine & Tobacco Research*, 15(9):1623-7, 2013. See also, Fiore, MC, et al., *Treating Tobacco Use and Dependence: 2008 Update, U.S. Public Health Service Clinical Practice Guideline*, May 2008, http://www.surgeongeneral.gov/tobacco/treating_tobacco_use08.pdf.

⁵¹ U.S. Preventive Services Task Force, *Behavioral and Pharmacotherapy Interventions for Tobacco Smoking Cessation in Adults, Including Pregnant Women*: U.S. Preventive Services Task Force Recommendation Statement, *Annals of Internal Medicine*, Vol. 163, No. 8, October 2015, <http://www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/tobacco-use-in-adults-and-pregnant-women-counseling-and-interventions1>.

⁵² King, BA, et al., "Awareness and Ever Use of Electronic Cigarettes Among U.S. Adults, 2010-2011," *Nicotine & Tobacco Research*, 15(9):1623-7, 2013. See also, King, BA, et al., "Trends in Awareness and Use of Electronic Cigarettes among U.S. Adults, 2010-2013," *Nicotine & Tobacco Research*, first published online September 19, 2014 and Fiore, MC, et al., *Treating Tobacco Use and Dependence: 2008 Update, U.S. Public Health Service Clinical Practice Guideline*, May 2008, http://www.surgeongeneral.gov/tobacco/treating_tobacco_use08.pdf.

⁵³ Bullen, C, et al., "Electronic cigarettes for smoking cessation: a randomised controlled trial," *The Lancet* 382(9905):1629-37, November 16, 2013; Capanetto, P, et al. "Efficiency and Safety of an eElectronic cigAreTte (ECLAT) as tobacco cigarettes substitute: a prospective 12-month pilot study," *PLoS One* 8(6):e66317, 2013.

⁵⁴ Biener, L. and J. Lee Hargrave, "A Longitudinal Study of Electronic Cigarette Use in a Population-based Sample of Adult Smokers: Association with Smoking Cessation and Motivation to Quit," *Nicotine & Tobacco Research*, October 9, 2014.

⁵⁵ Adkison, S, et al. "Electronic Nicotine Delivery Systems: International Tobacco Control Four-Country Survey," *American Journal of Preventive Medicine* 44(3):207-215, 2013; Vickerman, KA, et al., "Use of Electronic Cigarettes Among State Tobacco Cessation Quitline Callers," *Nicotine & Tobacco Research* 15(10):1787-91, October 2013.

⁵⁶ Giovenco, DP and Delnevo, CD, "Prevalence of population smoking cessation by electronic cigarette use status in a national sample of recent smokers," *Addictive Behaviors*, 76: 129-134, published online August 3, 2017.

⁵⁷ See e.g., Giovenco, DP and Delnevo, CD, "Prevalence of population smoking cessation by electronic cigarette use status in a national sample of recent smokers," *Addictive Behaviors*, 76: 129-134, published online August 3, 2017. Levy, DT, et al., "The relationship of e-cigarette use to cigarette quit attempts and cessation: insights from a large, nationally representative U.S. survey," *Nicotine & Tobacco Research*, published online August 31, 2017.

⁵⁸ Adkison, S, et al. "Electronic Nicotine Delivery Systems: International Tobacco Control Four-Country Survey," *Am J Prev Med*, 44(3):207-215, 2013.

⁵⁹ CDC, "Powerful new Tips from Former Smokers" ads focus on living with vision loss and colorectal cancer," CDC Press Release, March 26, 2015, <http://www.cdc.gov/media/releases/2015/p0326-tips.html>. See also: CDC, "Dual Use of Tobacco Products." <http://www.cdc.gov/tobacco/campaign/tips/diseases/dual-tobacco-use.html#ten>

⁶⁰ Schane, RE, Ling, PM, & Glantz, SA, "Health Effects of Light and Intermittent Smoking: A Review," *Circulation* 121(3):1518-1522, 2010.

⁶¹ Tverdal, A and Bjartveit, K, "Health Consequences of Smoking 1-4 Cigarettes per Day," *Tobacco control* 14(5), 2005.

⁶² HHS, *The Health Consequences of Smoking: A Report of the Surgeon General*, CDC, OSH, 2004. HHS, *How Tobacco Smoke Causes Disease: The Biology and Behavioral Basis for Smoking-Attributable Disease*, CDC, OSH, 2010. HHS, *Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General*, CDC, OSH, 2012, <http://www.surgeongeneral.gov/library/reports/preventing-youth-tobacco-use/index.html>. HHS, *The Health Consequences of Smoking: 50 Years of Progress. A Report of the Surgeon General*, CDC, OSH, 2014, Schane, RE, Ling, PM, & Glantz, SA, "Health Effects of Light and Intermittent Smoking: A Review," *Circulation* 121(3):1518-1522, 2010. Tverdal, A & Bjartveit, K, "Health consequences of reduced daily cigarette consumption," *Tobacco Control* 15:472-480, 2006.