



ELECTRONIC CIGARETTES AND YOUTH

A significant number of youth are using electronic cigarettes (e-cigarettes)^{*}, which provide a relatively new way to deliver the addictive substance nicotine without burning tobacco. The number of youth using e-cigarettes is alarming and raises serious concerns that e-cigarettes could be an entryway to nicotine addiction and use of regular cigarettes for some kids. 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. In December 2018, the Surgeon General issued an advisory on e-cigarette use among youth, declaring the growing problem an epidemic. The Surgeon General called for “aggressive steps to protect our children from these highly potent products that risk exposing a new generation of young people to nicotine.”¹

E-Cigarette Use Among Youth

According to 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), e-cigarettes have been the most commonly used tobacco product among youth since 2014. 5.3 million youth were current e-cigarette users in 2019 - an increase of over 3 million students since 2017. Among high school students, e-cigarette use increased by 135 percent from 2017 to 2019, increasing from 11.7% to 27.5%. Among middle school students, e-cigarette use more than tripled from 2017 to 2019, increasing from 3.3% to 10.5%.² As e-cigarette use has been increasing, youth are also initiating at younger and younger ages. In 2018, 28.6% of high schoolers who had tried e-cigarettes initiated prior to age 14, compared to just 8.8% in 2014.³

Among those who had used e-cigarettes in the past 30 days, 34.2% of high schoolers and 18% of middle schoolers were frequent users of e-cigarettes, using e-cigarettes on at least 20 of the preceding 30 days. 21.4% of high school e-cigarette users and 8.8% of middle school e-cigarette users were daily users, a strong indication of addiction. This amounts to 1.6 million middle and high school students who were frequent users of e-cigarettes, including nearly 1 million (970,000) daily users. Data from another national survey, the 2019 Monitoring the Future study, found that one out of nine high school seniors (11.7%) report that they vaped nicotine nearly daily, a strong indication of addiction.⁴

From 2017 to 2019, the increase in e-cigarette use drove a 59% increase in use of any tobacco product among high school students (from 19.6% in 2017 to 31.2% in 2019).⁵ Earlier data from the 2015 NYTS shows that 13.1%[†] of high school students who have never used another tobacco product have tried e-cigarettes.⁶ Similar patterns exist for young adults; the 2014 NHIS data found that nearly 10% of 18 to 24 year olds who have never smoked cigarettes had tried an e-cigarette.⁷

There is concern that use of e-cigarettes may function as a gateway to the use of more dangerous, combustible tobacco products. In 2016, the Surgeon General concluded that while more research is needed, evidence from several longitudinal studies suggests that e-cigarette use is “strongly associated” with the use of other tobacco products among youth and young adults, including conventional cigarettes.⁸ Reviewing a more recent and larger evidence base, a 2018 report by the National Academies of Science, Engineering and Medicine (NASEM) found the effect of e-cigarette use on cigarette smoking initiation to be causal, concluding that “There is substantial evidence that e-cigarette use increases risk of ever using combustible tobacco cigarettes among youth and young adults.” An analysis of data from the FDA’s nationally representative Population Assessment of Tobacco and Health (PATH) study found that from 2013 to 2016, youth (ages 12-15) e-cigarette use was associated with more than four times the odds of trying cigarettes and nearly three times the odds of current cigarette use. The researchers estimate that this translates to over 43,000 current youth cigarette smokers who might not have become smokers

^{*} The term “electronic cigarette” covers a wide variety of products now on the market, from those that look like cigarettes or pens to somewhat larger products like “tank systems” and “closed system” products like JUUL.

[†] Based on earlier data, CDC researchers reported that the number of youth who had used e-cigarettes, *but had never smoked a regular cigarette*, increased from 79,000 in 2011 to more than 263,000 in 2013. These same data for 2016 have not been released for youth.

without e-cigarettes.⁹ The NASEM report also concluded, “There is moderate evidence that e-cigarette use increases the frequency of subsequent combustible tobacco cigarette use” among youth and young adults.¹⁰ In addition, several studies find that the link between e-cigarette use and smoking initiation was stronger for those who had *lower* risk factors for smoking at baseline.¹¹ In 2018, the Surgeon General declared that “any e-cigarette use among young people is unsafe, even if they do not progress to future cigarette smoking.”¹²

The e-cigarette marketplace continues to change rapidly. According to the 2015 NYTS, the majority (53.4%) of youth e-cigarette users report using a rechargeable or refillable e-cigarette.¹³ Recently, sales of e-cigarettes shaped like flash drives that have replaceable nicotine pods (such as [JUUL](#)) have increased dramatically and are reported to be popular among youth and young adults.¹⁴ According to the 2018 Monitoring the Future Survey, more than 60% of 10th grade students say it is easy to get vaping devices and e-liquids.¹⁵ While most youth e-cigarette user (72.2%) report getting their e-cigarettes from friends and other social sources, some underage minors are able to buy their own e-cigarettes. According to the 2018 NYTS, 16.5% of middle and high school e-cigarette users under 18 report obtaining e-cigarettes from a vape shop in the past month, 9.8% from a gas station or convenience store, and 5.7% from the Internet.¹⁶ Data from the 2016-2017 wave of FDA’s Population Assessment of Tobacco and Health (PATH) study found that 7.2% of current youth (ages 12-17) e-cigarette users reported that they usually get their e-cigarettes online.¹⁷

Flavored E-Cigarettes Attract Youth

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.”¹⁸ Cigarettes with specific characterizing flavors were prohibited in the U.S. on September 22, 2009, as part of the Family Smoking Prevention and Tobacco Control Act. However, this prohibition did not apply to other tobacco products, including e-cigarettes, which come in flavors with obvious youth appeal such as gummy bear, cotton candy, and fruit punch.¹⁹ As of 2017, researchers had identified more than 15,500 unique e-cigarette flavors available online.²⁰ An earlier study of e-cigarette flavors found that among the more than 400 brands available online in 2014, 84% offered fruit flavors and 80% offered candy and dessert flavors.²¹ 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.²²

Research shows that flavored products are not only popular among youth, but may play a role in initiation and uptake of tobacco products. Data from the 2016-2017 wave of the PATH study found that 96.1% of 12-17 year olds who had initiated e-cigarette use since the last survey wave started with a flavored product. Additionally, it found that 97% of current youth e-cigarette users had used a flavored e-cigarette in the past month and 70.3% say they use e-cigarettes “because they come in flavors I like.”²³ While the methodology is not comparable to the PATH study, the 2019 NYTS found that 57.3% of high school e-cigarette users use mint or menthol flavors, an increase from 38.1% in 2018.²⁴ Among high school Juul users, mint is the most popular flavor.²⁵

E-Cigarette Marketing Reaches and Appeals to Youth

The Surgeon General concluded that, “Themes in e-cigarette marketing, including sexual content and customer satisfaction, are parallel to themes and techniques that have been found to be appealing to youth and young adults in conventional cigarette advertising and promotion.”²⁶ By mimicking the tobacco industry’s strategies, including celebrity endorsements, slick TV and magazine advertisements, and sports and music sponsorships, e-cigarette advertising has effectively reached youth and young adults. The 2016 NYTS found that 78.2% of middle and high school students—20.5 million youth—had been exposed to e-cigarette advertisements from at least one source, an increase from 68.9% in 2014.²⁷ Another study found that 82% of 12-17 year olds and 88% of 18-21 year olds reported seeing e-cigarette advertising in 2015.²⁸ The investment in e-cigarette marketing has been coupled with an increase in use among youth and young adults. A 2016 study in *Pediatrics*, analyzing 2014 NYTS 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.²⁹

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 the early years, from \$12 million in 2011 to \$125 million in 2014.³⁰ Other studies have also documented this significant increase in spending.³¹ These figures likely underestimate the true extent of e-cigarette advertising, as the available marketing data are not comprehensive (e.g., social media and sponsored events—strategies widely used by numerous e-cigarette companies—are not included).

An investigative report released in April 2014 by 11 members of Congress³² provided detailed evidence that e-cigarette manufacturers resurrected the marketing practices used by tobacco companies for decades to attract kids to smoking – including some tactics that have been prohibited for tobacco companies precisely because they appealed to kids. While cigarette advertising has been absent from TV and radio since 1971, TV advertising was the second highest tracked marketing expense among e-cigarette manufacturers in 2014. According to the Truth Initiative report, expenditures on e-cigarette television advertising totaled \$25.5 million in 2014.³³ These ads were strategically targeted to reach youth through network placement on television stations with clear youth appeal such as Comedy Central, ABC Family and MTV.³⁴ A study in *Pediatrics* found that from 2011 to 2013, exposure of youth aged 12-17 to e-cigarette advertisements on TV increased by 256%.³⁵ This same study estimated that e-cigarette advertisements may have reached an audience of up to 24 million youth. Research shows that these ads are effective—a randomized trial exposing adolescent e-cigarette non-users to such ads showed that they led to 50% higher intentions to use e-cigarettes.³⁶

In addition, youth are exposed to e-cigarette marketing at the point of sale. In 2012, nearly one-third of retailers sold e-cigarettes, with availability greatest in convenience stores and drug stores.³⁷ According to the 2019 NYTS, over half (58.4%) of middle and high school students had been exposed to e-cigarette advertisements in retail stores, the most common source of exposure to e-cigarette marketing.³⁸

Other tactics used by e-cigarette manufacturers to reach youth have included magazine ads that reach youth audiences; sponsorships and free samples at youth-oriented events such as auto races and music festivals; celebrity spokespeople who depict e-cigarette smoking as glamorous; and sweet, kid-friendly flavors with names like Cherry Crush, Chocolate Treat, Gummy Bear and Cotton Candy. The Congressional report found that many of the e-cigarette companies have also used social media to promote their products. E-cigarette companies market extensively on product websites and maintain a strong presence on social media sites popular among youth, like Facebook, YouTube, Instagram, and Twitter.³⁹ One study found nearly 74,000 tweets about e-cigarettes in just a two month period, most of which were sent by a few commercial enterprises.⁴⁰ E-cigarette manufacturers have also placed ads on search engines and websites that focus on music, entertainment, and sports and which often have substantial youth and young adult audiences.⁴¹ The companies rarely take steps to effectively prevent access to these websites by minors, as evidenced by data from the 2016 YTS, which found that 40.6% of high school students had been exposed to e-cigarette advertisements online.⁴² Another research study found that 40% of teens (ages 13-17) had seen e-cigarette advertisements online always, most or some of the time.⁴³

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, these benefits must be weighed against the current epidemic of use among youth. As the Surgeon General stated in a 2020 report, “The potential benefit of e-cigarettes for cessation among adult smokers cannot come at the expense of escalating rates of use of these products by youth.”⁴⁴

Many questions remain about the long-term health effects of these products and their effectiveness in helping smokers quit.⁴⁵ While we have much to learn about these new products, the evidence is already clear that it is unsafe for young people to use e-cigarettes or any other product containing nicotine.

As stated by the Surgeon General, “E-cigarette use poses a significant – and avoidable – health risk to young people in the United States. Besides increasing the possibility of addiction and long-term harm to brain development and respiratory health, e-cigarette use is associated with the use of other tobacco products that can do even more damage to the body.”⁴⁶

Poisoning and Exposure to Liquid Nicotine. Delivered in high doses, nicotine can be lethal. The Surgeon General’s report and the NASEM report both found that contact with e-liquids can cause adverse health effects and ingesting e-liquids can lead to death.⁴⁷ 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).⁴⁸ In 2014, more than half of these calls to poison hotlines were to report exposures among children under the age of six.⁴⁹ 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.

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.⁵⁰ According to the Surgeon General, “E-cigarette aerosol is not harmless. It can contain harmful and potentially harmful constituents, including nicotine.”⁵¹ The nicotine present in e-cigarette aerosol is absorbed by users and bystanders.⁵² 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.⁵³ 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.⁵⁴ A study of current adolescent e-cigarette users and dual users (e-cigarettes and cigarettes) found significantly higher levels of volatile organic compounds, some of which are carcinogenic, in those users compared to non-users.⁵⁵ Of note, similar levels of some these compounds were found in users of non-nicotine e-cigarettes, increasing the concern that even non-nicotine e-cigarettes increases exposure to harmful chemicals.⁵⁶ Because FDA has just begun to regulate e-cigarettes, which are available in hundreds of different brands⁵⁷, there is no way for consumers to know for sure yet what is in the products or the aerosol.⁵⁸

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 designation⁵⁹ have noted that it applies to ingestion, not for other exposures such as inhalation. The NASEM report committee expressed concern about flavor additives because even to-date, they “have not been widely tested for sensitizing, toxic, or irritating potency.”⁶⁰ 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.⁶¹ 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.⁶²

Impact of Nicotine. E-cigarettes and refill liquids contain widely varying levels of nicotine, and the nicotine delivered through the aerosol can also vary depending on the device characteristics and user practices.⁶³ 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.⁶⁴ 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.⁶⁵ Nicotine also impacts the cardiovascular system.⁶⁶ The Surgeon General concluded that, “The use of

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

2011	269
2012	459
2013	1,540
2014	4,012
2015	3,733
2016	2,899
2017	2,470
2018	3,139
2019*	5,183

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

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.”⁶⁷

Campaign for Tobacco-Free Kids, January 28, 2020 / Laura Bach

-
- ¹ Office of the Surgeon General, “Surgeon General’s Advisory on E-Cigarette Use Among Youth,” December 18, 2018, <https://e-cigarettes.surgeongeneral.gov/documents/surgeon-generals-advisory-on-e-cigarette-use-among-youth-2018.pdf>.
- ² Cullen, KA, et al., “e-Cigarette Use Among Youth in the United States, 2019” *JAMA*, published online November 5, 2019.
- ³ Evans-Polce, R, et al., “Trends in E-Cigarette, Cigarette Cigar, and Smokeless Tobacco Use Among US Adolescent Cohorts, 2014-2018,” *American Journal of Public Health*, 110(2): 163-165, 2020.
- ⁴ Miech, R, et al., “Trends in Adolescent Vaping, 2017-2019,” *New England Journal of Medicine*, published online September 18, 2019.
- ⁵ Cullen, KA, et al., “e-Cigarette Use Among Youth in the United States, 2019” *JAMA*, published online November 5, 2019.
- 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.
- ⁷ 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>.
- ⁸ 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, Leventhal, AM, et al., “Association of Electronic Cigarette Use With Initiation of Combustible Tobacco Product Smoking in Early Adolescence,” *Journal of the American Medical Association*, 314(7): 700-707, 2015. Wills, Thomas A, et al., “Longitudinal study of e-cigarette use and onset of cigarette smoking among high school students in Hawaii,” *Tobacco Control*, published online first January 25, 2016. Wills, TA, et al., “E-cigarette use is differentially related to smoking onset among lower risk adolescents,” *Tobacco Control*, published online August 19, 2016. Barrington-Trimis, JL, et al., “E-Cigarettes and Future Cigarette Use,” *Pediatrics*, 138(1), published online July 2016.
- ⁸ Barrington-Trimis, JL, et al., “E-Cigarettes and Future Cigarette Use,” *Pediatrics*, 138(1), published online July 2016. Wills, TA, et al., “E-cigarette use is differentially related to smoking onset among lower risk adolescents,” *Tobacco Control*, published online August 19, 2016.
- ⁹ Berry, KM, et al., “Association of Electronic Cigarette Use with Subsequent Initiation of Tobacco Cigarettes in US Youths,” *JAMA Network Open*, 2(2), published online February 1, 2019.
- ¹⁰ National Academies of Sciences, Engineering, and Medicine. 2018. *Public health consequences of e-cigarettes*. Washington, DC: The National Academies Press. <http://nationalacademies.org/hmd/Reports/2018/public-health-consequences-of-e-cigarettes.aspx>.
- ¹¹ Barrington-Trimis, JL, et al., “E-Cigarettes and Future Cigarette Use,” *Pediatrics*, 138(1), published online July 2016. Wills, TA, et al., “E-cigarette use is differentially related to smoking onset among lower risk adolescents,” *Tobacco Control*, published online August 19, 2016. Berry, KM, et al., “Association of Electronic Cigarette Use with Subsequent Initiation of Tobacco Cigarettes in US Youths,” *JAMA Network Open*, 2(2), published online February 1, 2019.
- ¹² Office of the Surgeon General, “Surgeon General’s Advisory on E-Cigarette Use Among Youth,” December 18, 2018, <https://e-cigarettes.surgeongeneral.gov/documents/surgeon-generals-advisory-on-e-cigarette-use-among-youth-2018.pdf>.
- ¹³ 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>.
- ¹⁴ Nielsen Total US xAOC/Convenience Database & Wells Fargo Securities, LLC, in Wells Fargo Securities, Nielsen: Tobacco ‘All Channel’ Data 12/30, January 9, 2018.
- ¹⁵ University of Michigan, 2018 Monitoring the Future Study, *Trends in Availability – Tables 15-17*. See <http://monitoringthefuture.org/data/18data/18drtbl15.pdf> and <http://monitoringthefuture.org/data/18data/18drtbl16.pdf>.
- ¹⁶ Liu, ST, et al., “Youth Access to Tobacco Products in the United States, 2016-2018,” *Tobacco Regulatory Science*, 5(6): 491-501, 2019.
- ¹⁷ FDA, “Modifications to Compliance Policy for Certain Deemed Products: Guidance for Industry, Draft Guidance,” March 13, 2019, <https://www.fda.gov/media/121384/download>.
- ¹⁸ 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.
- ¹⁹ See U.S. Food and Drug Administration’s Flavored Tobacco webpage at <http://www.fda.gov/TobaccoProducts/GuidanceComplianceRegulatoryInformation/FlavoredTobacco/default.htm>.
- ²⁰ Zhu, S-H, et al., “Evolution of Electronic Cigarette Brands from 2013-2014 to 2016-2017: Analysis of Brand Websites,” *Journal of Medical Internet Research*, 20(3), published online March 12, 2018.
- ²¹ 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.
- ²² Johnson, A, “Up in smoke? Alamance e-cigarette store operators concerned about proposed regulations,” *Times-News*, April 30, 2014, <http://www.thetimesnews.com/news/top-news/up-in-smoke-alamance-e-cigarette-store-operators-concerned-about-proposed-regulations-1.313005>. The website for VapeRite ATL also notes that customers can “mix well over 100,000 possible flavor and mix type combinations” [<https://atlanta.vaperite.com/#vape-bar>, accessed May 30, 2014].
- ²³ FDA, “Modifications to Compliance Policy for Certain Deemed Products: Guidance for Industry, Draft Guidance,” March 13, 2019, <https://www.fda.gov/media/121384/download>.
- ²⁴ Cullen, KA, et al., “e-Cigarette Use Among Youth in the United States, 2019” *JAMA*, published online November 5, 2019.
- ²⁵ Leventhal, AM, et al., “Flavors of e-Cigarettes Used by Youths in the United States,” *JAMA*, published online November 5, 2019.

- ²⁶ 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.
- ²⁷ Marynak, K., et al., "Exposure to Electronic Cigarette Advertising Among Middle and High School Students—United States, 2014-2016," *MMWR* 67(10): 294-299, March 16, 2018, <https://www.cdc.gov/mmwr/volumes/67/wr/pdfs/mm6710a3-H.pdf>.
- ²⁸ 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>.
- ²⁹ Singh, T., et al., "Exposure to Advertisements and Electronic Cigarette Use Among US Middle and High School Students," *Pediatrics*, published online April 25, 2016. See also Dai, H and Hao, J, "Exposure to Advertisements and Susceptibility to Electronic Cigarette Use Among Youth," *Journal of Adolescent Health*, published online August 12, 2016.
- ³⁰ 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.
- ³¹ 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>.
- ³² "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>.
- ³³ 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>.
- ³⁴ Duke, JC, et al., "Exposure to Electronic Cigarette Television Advertisements Among Youth and Young Adults," *Pediatrics* 134(1):e29-36, July 2014.
- ³⁵ Duke, JC, et al., "Exposure to Electronic Cigarette Television Advertisements Among Youth and Young Adults," *Pediatrics* 134(1):e29-36, July 2014.
- ³⁶ Farrelly, M. *A Randomized Trial of the Effect of E-cigarette Television Ads on Intentions to Use E-Cigarettes*. Presentation at the FDA "Electronic Cigarettes and the Public Health: A Public Workshop," June 1, 2015.
- ³⁷ Giovenco, DP, et al., "E-Cigarette Market Trends in Traditional U.S. Retail Channels, 2012–2013," *Nicotine & Tobacco Research* advance access, doi:10.1093/ntr/ntu282, January 15, 2015; Rose, SW, et al., "The availability of electronic cigarettes in US retail outlets, 2012: results of two national studies," *Tobacco Control*, 23:iii10-iii16, 2014.
- ³⁸ CDC, "Tobacco Product Use and Associated Factors Among Middle and High School Students—United States, 2019," *MMWR* 68(12): December 6, 2019, <https://www.cdc.gov/mmwr/volumes/68/ss/pdfs/ss6812a1-H.pdf>.
- ³⁹ "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>. See also, Noel, JK, Rees, VW, & Connolly, GN, "Electronic cigarettes: a new 'tobacco' industry?" *Tobacco Control* 20:81, 2011.
- ⁴⁰ Huang, J, et al., "A cross-sectional examination of marketing of electronic cigarettes on Twitter," *Tobacco Control* 23:iii26-iii30, 2014.
- ⁴¹ Richardson, A, et al., "Tobacco on the web: surveillance and characterization of online tobacco and e-cigarette advertising," *Tobacco Control*, Published Online First: February 14, 2014.
- ⁴² Marynak, K., et al., "Exposure to Electronic Cigarette Advertising Among Middle and High School Students—United States, 2014-2016," *MMWR* 67(10): 294-299, March 16, 2018, <https://www.cdc.gov/mmwr/volumes/67/wr/pdfs/mm6710a3-H.pdf>.
- ⁴³ 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>.
- ⁴⁴ HHS, *Smoking Cessation. 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, 2020.
- ⁴⁵ CDC, "Electronic Cigarettes." https://www.cdc.gov/tobacco/basic_information/e-cigarettes/index.htm. Accessed March 16, 2018.
- ⁴⁶ HHS, *Know the Risks: E-Cigarettes & Young People*, accessed March 15, 2018 at <https://e-cigarettes.surgeongeneral.gov/knowtherisks.html>.
- ⁴⁷ 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. NASEM, *Public Health Consequences of E-Cigarettes*, 2018.
- ⁴⁸ American Association of Poison Control Centers, "Electronic Cigarette and Liquid Nicotine," <http://www.aapcc.org/alerts/e-cigarettes/>.
- ⁴⁹ 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>.
- ⁵⁰ CDC, "Dual Use of Tobacco Products." <http://www.cdc.gov/tobacco/campaign/tips/diseases/dual-tobacco-use.html#ten>. Accessed November 19, 2015.
- ⁵¹ 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.

⁵² CDC, "Dual Use of Tobacco Products." <http://www.cdc.gov/tobacco/campaign/tips/diseases/dual-tobacco-use.html#ten>. Accessed November 19, 2015.

⁵³ 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>.

⁵⁴ 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>.

⁵⁵ Rubenstein, ML, et al., "Adolescent Exposure to Toxic Volatile Organic Chemicals from E-Cigarettes," *Pediatrics* 141(4):e20173557, 2018.

⁵⁶ Rubenstein, ML, et al., "Adolescent Exposure to Toxic Volatile Organic Chemicals from E-Cigarettes," *Pediatrics* 141(4):e20173557, 2018.

⁵⁷ 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.

⁵⁸ CDC, "Dual Use of Tobacco Products." <http://www.cdc.gov/tobacco/campaign/tips/diseases/dual-tobacco-use.html#ten>. Accessed November 19, 2015.

⁵⁹ 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>.

⁶⁰ NASEM, *Public Health Consequences of E-Cigarettes*, 2018, p. 5-31.

⁶¹ 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.

⁶² 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.

⁶³ NASEM, *Public Health Consequences of E-Cigarettes*, 2018.

⁶⁴ 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>.

⁶⁵ 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>

⁶⁶ 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/>.

⁶⁷ 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.