



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. A 2018 report from the National Academies of Sciences, Engineering, and Medicine (NASEM) found that e-cigarettes are less harmful than cigarettes, but are not risk-free.¹ The report also found that many questions remain about the long-term health effects of these products for individual users and about the population-wide effects. In a 2020 report, the Surgeon General found that “the long-term health effects of using these products remain unknown, and short-term risks are only slowly coming into focus.”²

Research is still needed to determine whether or not e-cigarettes will help people quit, discourage smokers from quitting completely, or lead to established tobacco use for new users, including kids, especially in an environment where the products continue to evolve. In December 2018, the Surgeon General issued an advisory on e-cigarette use among youth, “officially declaring e-cigarette use among youth an epidemic in the United States.” He called for “aggressive steps to protect our children from these highly potent products that risk exposing a new generation of young people to nicotine.”³

What are Electronic Cigarettes?

The term “electronic cigarettes” covers a wide variety of products now on the market, from those that look like cigarettes, pens or USB drives 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 and “pods,” 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. There are also “mods,” which are units that users assemble themselves from separate component parts, to allow variation in battery power, style, and size.⁴ A study found more than 430 brands of e-cigarettes available for purchase online in 2017.⁵ As of November 29, 2020, pre-filled cartridges for pods made up 66.1% of sales in traditional retail outlets,[†] while disposable e-cigarettes made up 33.9%, more than doubling their market share since January 2020.⁶



Sample of e-cigarette products. Images are not to scale.

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

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

† Convenience stores, gas stations, grocery stores, drugstores/pharmacies, mass merchandiser outlets, club stores, dollar stores, and military sales. Excludes Internet sales and sales from tobacco specialty stores like vape shops.

strawberry, which have long been considered attractive to kids. By 2017, researchers identified more than 15,500 unique e-cigarette flavors available online.⁷ In addition to the vast selection available online, some vape shops allow consumers to purchase refill liquids, including a combination of flavors chosen by the user and in varying levels of nicotine.

The popularity of various flavors of e-cigarettes has changed over time. When e-cigarettes were first introduced in the U.S., only tobacco and menthol flavors were available, but very quickly, the number of flavors exploded. Beginning in 2017, as the popularity of Juul surged, other flavors like fruit, dessert and candy made up the largest portion of sales.⁸ However, sales of mint-flavored products grew when Juul removed its mango, cucumber, and crème flavors from the market in late 2018.⁹ When Juul stopped sales of mint-flavored products in late 2019¹⁰ and the FDA prohibited sale of cartridge-based products in flavors other than tobacco and menthol in February 2020, menthol-flavored e-cigarette sales grew dramatically. Sales of menthol flavored e-cigarettes increased by 55.9% between January 26 and November 29, 2020. As of November 2020, menthol-flavored products made up 42.5% of all unit sales and 61% of sales of cartridge-based products like Juul. Menthol sales are followed in popularity by tobacco (27.6%), all others (26.5%), and mint (2.6%).¹¹

Currently, no reliable estimate of the size of the e-cigarette market exist, but the latest available projection of the e-cigarette market, including vape shops and internet sales, was approximately \$9 billion in the U.S. in 2019.¹² The three major U.S. tobacco companies – Altria/Philip Morris, Reynolds American/Lorillard, and ITG Brands – have all invested in the e-cigarette market with their own brands, though in late 2018, Altria announced it would end sales of its e-cigarette products and made a \$12.8 billion investment in Juul Labs (for a 35% stake in the company).¹³ 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% of e-cigarettes are estimated to be manufactured in or sourced from China.¹⁴

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.”¹⁵ 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.¹⁶

Some e-cigarette marketing tactics include 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 use as glamorous; social media marketing; and sweet, kid-friendly flavors with names like Cherry Crush, Chocolate Treat, Cotton Candy, and Gummy Bear.

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. Studies of e-cigarette marketing expenditures found dramatic increases in the early years.¹⁷ Analysis of more recent marketing spending found a decline between 2014 and 2017, but then a more than doubling between 2017 and 2018, to \$110 million. Juul accounted for the majority of spending that year.¹⁸ 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).

Social media helps to fuel the popularity of e-cigarettes, including the top-selling e-cigarette brand, Juul. A study analyzing Juul marketing noted that Juul was one of the first major e-cigarette brands to rely heavily on social media to market and promote its products. The study found that Juul’s initial marketing expenditures in traditional channels were modest compared to competing brands, and that these expenditures decreased as the brand increased content and received more promotion on social media channels like Instagram and Twitter.¹⁹

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.”²⁰ The 2019 National Youth Tobacco Survey (NYTS) found that 69.3% of middle and high school students – 18.3 million youth – had been exposed to e-cigarette advertisements from at least one source.²¹ 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.²²

Use of E-Cigarettes Among Adults and Youth

E-cigarettes have been the most popular tobacco product among youth since 2014, and the number of youth using e-cigarettes is alarming and raises serious concerns. It is still an open scientific question whether e-cigarettes might be able to help adult smokers give up cigarettes; however, kids should not be using any tobacco product, including e-cigarettes.

While e-cigarettes have become increasingly popular among youth and young adults, uptake has remained low among older adults. About 25% of all e-cigarette users in the US are youth, and 44% are under age 25.²³

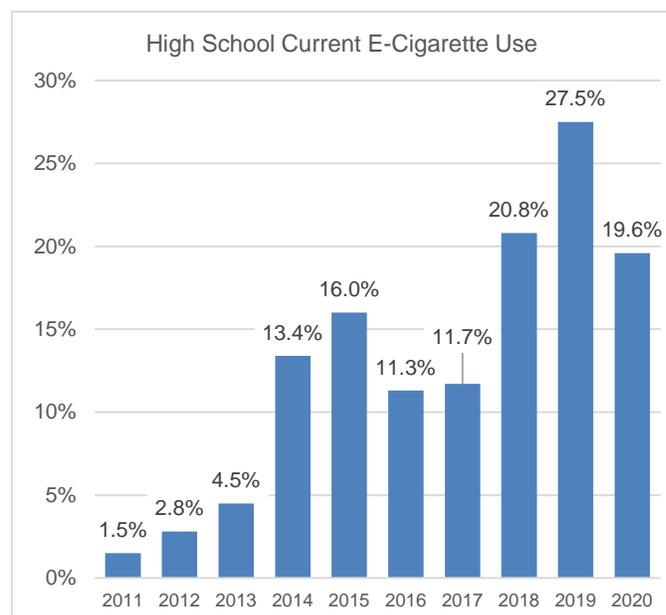
Youth Use. According to the NYTS, high school e-cigarette use declined to 19.6% in 2020, after increasing by 135% from 2017 to 2019 (from 11.7% to 27.5%).²⁴ Among middle school students, e-cigarette use declined to 4.7% in 2020, after more than tripling from 2017 to 2019 (from 3.3% to 10.5%). While the significant decline in youth users since 2019 is a sign of progress, youth e-cigarette use remains high. In 2020, 3.6 million kids still use e-cigarettes – the same number as when the U.S. Surgeon General called youth e-cigarette use an “epidemic” in 2018.²⁵

The same survey found that among those who had used e-cigarettes in the past 30 days, an increasing proportion of youth e-cigarette users are showing signs of addiction. In 2020, 38.9% of high schoolers used e-cigarettes on at least 20 of the preceding 30 days (up from 34.2% in 2019).

Twenty percent of middle school users were frequent users of e-cigarettes (up from 18% in 2019). Alarming, 22.5% of high school e-cigarette users and 9.4% of middle school e-cigarette users were daily users, a strong indication of addiction. This amounts to 1.3 million middle and high school students who were frequent users of e-cigarettes, including over 730,000 daily users.²⁶

Multiple national surveys show that flavored e-cigarettes are popular among youth. Data from the 2016-2017 wave of FDA’s Population Assessment of Tobacco and Health (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.”²⁷ More recently, the 2020 NYTS found that an increasing proportion of middle and high school e-cigarette users reported using flavored products in 2020 (82.9%, up from 68.8% in 2019). Among high school students who currently used any type of flavored e-cigarette, the most commonly used flavor types were fruit (73.1%), mint (55.8%), menthol (37%), and candy, desserts, or other sweets (36.4%).²⁸ While the methodology is not comparable to the PATH study, both surveys confirm that flavors are an important reason youth use e-cigarettes.

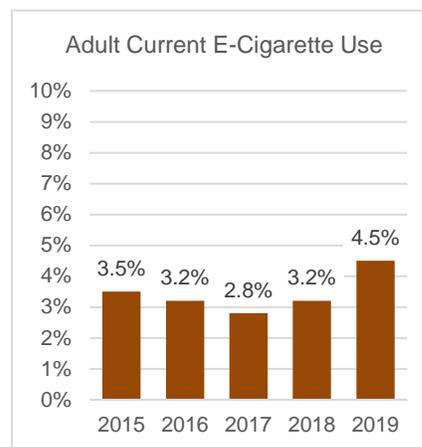
Among youth, the most popular e-cigarette devices are refillable cartridge (or “pod”) systems like Juul. In 2020, about half (48.5%) of high school e-cigarette users reported that their most commonly used device type was prefilled pods or cartridges. However, disposable e-cigarettes like Puff Bar and Mojo have



surged in popularity among youth due to the wide array of flavors that are now prohibited in cartridge systems. Among high school current e-cigarette users, use of disposable e-cigarettes increased by 1,000% from 2019 to 2020 (from 2.4% to 26.5%).²⁹ Puff Bar, a disposable e-cigarette, was the third most popular brand among 10th and 12th grader e-cigarette users in 2020.³⁰

Adult Use. Data from the National Health Interview Survey (NHIS) show that in 2019, 4.5% of adults currently used e-cigarettes every day or some days, an increase from 3.2% in 2018.³¹

- E-cigarette use is highest among younger adult populations. Compared to 3.0% of 45-64 year olds, 9.3% of 18-24 year olds currently use e-cigarettes every day or some days, an increase from 7.6% in 2018. Among all tobacco products, e-cigarettes were used by the highest proportion of 18-24 year olds (24.5%).
- A higher percentage of White, non-Hispanic adults use e-cigarettes (5.1%) compared to Black, non-Hispanic adults (3.4%) or Hispanic adults (2.8%).



As young adult e-cigarette use continues to rise, an increasing number of these young e-cigarette users have never been smokers. In 2019, NHIS data showed that more than half of 18-24 year-old current e-cigarette users (56.0%) had never smoked cigarettes, the highest proportion among the age groups. This youngest adult age group also had the lowest percentage of e-cigarette users who were former smokers.³² Similarly, data from the Behavioral Risk Factor Surveillance System (BRFSS), show that the proportion of young adult never smokers using e-cigarette users roughly doubled between 2016 and 2018, while e-cigarette use rates among older adult never smokers changed very little.³³

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 combustible cigarettes and die of tobacco-related disease. However, these potential 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.”³⁴

According to CDC and the 2018 NASEM report on e-cigarettes, e-cigarettes are less harmful than combustible cigarettes, but that doesn’t mean that they are safe or without risk.³⁵ The Surgeon General found that “the long-term health effects of using these products remain unknown, and short-term risks are only slowly coming into focus.” The NASEM report stated that “the absolute risks of the products cannot be unambiguously determined at this time,” and there is little data to assess the impact on cancer and heart disease risk.³⁶ Thus, many questions still remain about the potential long-term risks to the public health posed by these products.

Individual-Level Health Risks

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.³⁷ According to the Surgeon General, “E-cigarette aerosol is not harmless. It can contain harmful and potentially harmful constituents, including nicotine.”³⁸ The nicotine present in e-cigarette aerosol is absorbed by users and bystanders.³⁹ 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.⁴⁰ 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.⁴¹ Because FDA has just begun to regulate e-cigarettes, which are available in hundreds of different brands,⁴² there is no way for consumers to know for sure yet what is in the products or the aerosol.⁴³

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 designation⁴⁴ 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.”⁴⁵ 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.⁴⁶ 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.⁴⁷

FDA has been investigating a possible link between e-cigarettes and seizures, finding that more than 125 incidents, particularly among youth and young adults, have been reported between 2010 and 2019.⁴⁸

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.⁴⁹ More recently, e-liquids have been formulated with nicotine salts, which, according to the Surgeon General, “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.”⁵⁰ While e-cigarettes can be used for non-nicotine products, including marijuana, the vast majority of e-cigarette products sold in traditional retail stores contain nicotine,⁵¹ and more than two-thirds of youth e-cigarette users report using e-cigarettes exclusively for nicotine-containing products.⁵²

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.⁵³ 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.”⁵⁴

In general, nicotine has been found to impact the cardiovascular system.⁵⁵ The NASEM report found that the nicotine in e-cigarettes can increase heart rate and diastolic blood pressure in users shortly after use, but evidence was not available to determine an association between e-cigarette use and other cardiovascular outcomes such as heart disease and stroke. However, the NASEM report acknowledged that the nicotine in e-cigarettes could elevate cardiovascular disease risk in users with pre-existing cardiovascular disease.⁵⁶

Poisoning and Exposure to Liquid Nicotine. Delivered in high doses, nicotine can be lethal. The Surgeon General’s 2016 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.⁵⁷ Exposure to liquid nicotine found in e-cigarettes has resulted in thousands of calls to poison control centers in recent years, according to the American Association of Poison Control Centers (AAPCC).⁵⁸ In 2014, more than half of these calls to poison hotlines were to report exposures among children under the age of six.⁵⁹ 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.

Population-Level Health Concerns

Youth and Young Adults. The number of youth using e-cigarettes raises serious concerns that e-cigarettes may function as a gateway to the use of more dangerous, combustible tobacco products.

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

2011	269
2012	459
2013	1,540
2014	4,011
2015	3,733
2016	2,899
2017	2,470
2018	3,139
2019	5,356
2020*	3,829
Through Jan. 2021*	407

* Preliminary data, as poison centers continue to update their reports. Call volume increased in late 2019, as health officials investigated a national outbreak of e-cigarette, or vaping, product use-associated lung injury (EVALI).

- 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.⁶⁰
- The NASEM report concluded that “[t]here is substantial evidence that e-cigarette use increases risk of ever using combustible tobacco cigarettes among youth and young adults.”⁶¹
- 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 without e-cigarettes.⁶²
- New research shows that the latest generation of high nicotine e-cigarettes like Juul that have fueled the youth e-cigarette epidemic are also associated with subsequent smoking initiation. An analysis of 2017-2019 data from the Truth Longitudinal Cohort, a study of young and young adults (ages 15-27), found that compared with those who had never used an e-cigarette, those who reported ever use of any e-cigarette (Juul or other brands) in 2018 had significantly higher odds of ever cigarette use one year later, and those who reported ever use of Juul in 2018 had significantly higher odds of current e-cigarette use one year later.⁶³

Dual Use and Cessation. Data show that a significant number of e-cigarette users report using both e-cigarettes and conventional cigarettes, raising additional concerns beyond the potential health effects of e-cigarettes alone.

Many e-cigarette users report using both e-cigarettes and cigarettes. According to the 2019 NHIS, 36.9% of adult e-cigarette users are also current cigarette smokers (dual users) while 23.6% had never been smokers.⁶⁴

Little data are available on what happens with dual users over time. Analysis of PATH data found that nearly 9 out of 10 early dual users were still smoking cigarettes at follow-up. Among adults who were dual users of e-cigarettes and cigarettes at Wave 1 (2013-2014), 44.3% maintained dual use, 43.5% discontinued e-cigarette use but maintained cigarette smoking, and only 12.1% discontinued cigarette use (5.1% discontinued cigarette use but continued e-cigarette use and 7.0% discontinued use of both products) at Wave 2 (2014-2015).⁶⁵ A study using 2013-2014 PATH data found that dual users had toxicant exposures that were similar to those who only used cigarettes.⁶⁶

Some e-cigarette users report that they believe that e-cigarettes will help them quit or reduce the number of cigarettes they smoke.⁶⁷ While existing research is limited and provides mixed results about the effectiveness of e-cigarettes in helping current smokers successfully quit, leading public health authorities have found that there is not enough evidence to conclude whether e-cigarettes are a safe and effective smoking cessation device.⁶⁸

- The 2020 Surgeon General Report on Smoking Cessation, released in January 2020, concluded that “there is presently inadequate evidence to conclude that e-cigarettes, in general, increase smoking cessation.” The Surgeon General also cautions that because e-cigarettes are not a single product, but “a continually changing and heterogeneous group of products” that “are used in a variety of ways,” it is difficult to make broad generalizations about the efficacy of e-cigarettes for smoking cessation based upon any one study or any one product.⁶⁹
- 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 updated its recommendation statement on tobacco smoking cessation adults and concluded that “the current evidence is insufficient to assess the balance of benefits and harms of electronic cigarettes (e-cigarettes) for tobacco cessation in adults, including pregnant persons.”⁷⁰
- The NASEM report concluded, “[o]verall, there is limited evidence that e-cigarettes may be effective aids to promote smoking cessation.”⁷¹
- 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.”⁷²

However, some research does suggest some types of e-cigarettes used under certain conditions may help smokers quit. For example, a study published in the *New England Journal of Medicine (NEJM)* found that certain electronic cigarettes may be effective at helping smokers quit traditional cigarettes when combined with behavioral support. The study, of smokers attending stop smoking services through the U.K. National Health Service, found that at one year follow-up, the quit rate among smokers in the e-cigarette group was 18%, compared to 9.9% in the nicotine-replacement group.⁷³ A 2018 longitudinal study using PATH data found that cigarette smokers who used e-cigarettes daily had significantly greater odds of quitting compared to non e-cigarette users.⁷⁴ Product type is also an important factor, with one study noting that while daily use of tank-based or non-cartridge based e-cigarettes increases the likelihood of cessation, other types of e-cigarettes do not, even when used daily.⁷⁵

Two recent studies using PATH data reinforce findings from earlier studies that using e-cigarettes was no more effective in helping smokers quit compared to nicotine replacement therapy (NRT) or other FDA-approved pharmacotherapies. However, like the *NEJM* study described earlier, these studies found that the majority of those who used e-cigarettes to quit smoking were continuing to use e-cigarettes afterwards.⁷⁶ Similarly, two older 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 nicotine replacement therapy (NRT).⁷⁷

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.⁷⁸ A 2018 study by Weaver et. al., did not find any evidence that ENDS help adult smokers quit at a higher rate than smokers who did not use these products despite ENDS users being more likely to make a quit attempt. In fact, the authors state that “findings indicate that, at the time of this study, ENDS under “real world” use and conditions may have suppressed or delayed quitting among some adult smokers.”⁷⁹ A meta-analysis of 38 studies that examined the association between e-cigarette use and smoking cessation among adult smokers found that the odds of quitting were less among smokers using e-cigarettes.⁸⁰

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.⁸¹ A more recent study (Weaver et. al.) did not find that the use of ENDS was associated with a reduction in cigarette consumption among those participants who had not quit smoking at follow-up.⁸² 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. The NASEM report stated that a “reduction in rate of smoking does not ensure reduction in tobacco-related harm” and that, “there is no available evidence whether or not long-term e-cigarette use among smokers (dual use) changes morbidity or mortality compared with those who only smoke combustible tobacco cigarettes.”⁸³ 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.”⁸⁴

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. 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.⁸⁵

Studies have found that smoking just one to four cigarettes a day increases the risk of developing or dying from heart diseases.⁸⁶ A recent review of 141 studies that examined the relationship between cigarette consumption and the risk for cardiovascular disease and stroke found that smoking even one cigarette per day carries a very high risk for developing cardiovascular disease and stroke. The authors concluded that, “Smokers need to quit completely rather than cut down if they wish to avoid most of the risk associated with heart disease and stroke.”⁸⁷ 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.⁸⁸

Important unanswered questions:

- *What are the long term health impacts of e-cigarette use?*
- *Do e-cigarettes help smokers quit more effectively than FDA-approved cessation products?*
- *Currently, six in ten adult e-cigarette users are either dual users (continue to smoke cigarettes) or had never smoked in the first place. Will most e-cigarette users continue to be dual-users or never users?*
- *Will e-cigarette marketing renormalize tobacco use?*
- *Research shows a strong association between e-cigarette use and subsequent combustible cigarette smoking among youth and young adults. Will that translate into increased smoking rates in the long-term?*
- *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.

Campaign for Tobacco-Free Kids, February 5, 2021

¹ National Academies of Sciences, Engineering, and Medicine (NASEM), *Public Health Consequences of E-Cigarettes*, Washington, DC: The National Academies Press, 2018, <http://nationalacademies.org/hmd/Reports/2018/public-health-consequences-of-e-cigarettes.aspx>.

² HHS, Office of the Surgeon General, "Smoking Cessation: A Report of the Surgeon General," 2020 <https://www.hhs.gov/sites/default/files/2020-cessation-sgr-full-report.pdf>.

³ 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>.

⁴ Wells Fargo, *Vape Shops – Springing Up Across The Country*, April 14, 2014.

⁵ 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.

⁶ CDC Foundation, *Monitoring U.S. E-Cigarette Sales: National Trends*, November 2020, <https://www.cdcfoundation.org/E-CigaretteSales-DataBrief-Nov2020?inline>. Sales data are from IRI, Inc., which covers convenience stores, gas stations, grocery stores, drugstores/pharmacies, mass merchandiser outlets, club stores, dollar stores, and military sales, but not internet sales or vape shops.

⁷ 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.

⁸ Ali, FRM, et al., "E-Cigarette Unit Sales, by Product and Flavor Type – United States, 2014-2010," *MMWR ePub*, September 9, 2020, <https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6937e2-H.pdf>.

⁹ Ali, FRM, et al., "E-Cigarette Unit Sales, by Product and Flavor Type – United States, 2014-2010," *MMWR ePub*, September 9, 2020, <https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6937e2-H.pdf>.

Juul Labs, "Juul Labs Action Plan," November 13, 2018, <https://newsroom.juul.com/2018/11/13/juul-labs-action-plan/>.

¹⁰ Juul Labs, "Juul Labs Stops the Sale of Mint JuulPods in the United States," November 7, 2019, <https://newsroom.juul.com/juul-labs-stops-the-sale-of-mint-juulpods-in-the-united-states/>.

¹¹ CDC Foundation, *Monitoring U.S. E-Cigarette Sales: National Trends*, November 2020, <https://www.cdcfoundation.org/E-CigaretteSales-DataBrief-Nov2020?inline>.

¹² Wells Fargo Securities, *Nielsen: Tobacco 'All Channel' Data 10/5*, October 15, 2019.

¹³ Altria, "Altria Refocuses Innovative Product Efforts," Press Release, December 7, 2018, <http://www.altria.com/Media/Press-Releases/Pages/PressReleaseDetails.aspx?reqID=2379931>. Altria, "Altria Makes \$12.8 Billion Minority Investment in Juul to Accelerate Harm Reduction and Drive Growth," December 20, 2018, <http://www.altria.com/Media/Press-Releases/Pages/PressReleaseDetails.aspx?reqID=2381292>.

¹⁴ U.S. 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. 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.

¹⁵ HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: HHS, U.S. Centers for Disease Control and Prevention (CDC), National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2016.

¹⁶ "Gateway to Addiction? A Survey of Popular Electronic Cigarette Manufacturers and Marketing to Youth," A report written by the staff of Senator Richard J. Durbin (D-IL), Representative Henry A. Waxman (D-CA), Senators Tom Harkin (D-IA), John D. Rockefeller IV (D-WV), Richard Blumenthal (D-CT), Edward J. Markey (D-MA), Sherrod Brown (D-OH), Jack Reed (D-RI), Barbara Boxer (D-CA), Jeff Merkley (D-OR), and Representative Frank Pallone Jr. (D-NJ), April 14, 2014, <https://www.markey.senate.gov/imo/media/doc/Report-E-Cigarettes-Youth-Marketing-Gateway-To-Addiction-2014-4-14.pdf>.

¹⁷ 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. 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. Truth Initiative, *Vaporized: Youth and Young Adult Exposure to E-Cigarette Marketing*, November 2015, <https://truthinitiative.org/sites/default/files/media/files/2019/03/Vaporized-Youth-Exposure-To-E-Cigarette-Marketing.pdf>.

¹⁸ Ali, FRM, et al. "E-cigarette advertising expenditures in the United States, 2014-2018," *Tobacco Control*, Published Online First, doi: 10.1136/tobaccocontrol-2019-055424, February 27, 2020.

¹⁹ Huang, J, et al., "Vaping versus Juuling: how the extraordinary growth and marketing of Juul transformed the US retail e-cigarette market," *Tobacco Control*, published online May 31, 2018.

²⁰ HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: HHS, CDC, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2016.

²¹ Wang, TW, et al., "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>.

²² Singh, T, et al., "Exposure to Advertisements and Electronic Cigarette Use Among US Middle and High School Students," *Pediatrics*, published online April 25, 2016.

²³ 3.6 million middle and high school students are current e-cigarette users and 10.9 million adults are current e-cigarette users (about 2.3 million of whom are young adults). Cornelius, ME, "Tobacco Product Use Among Adults — United States, 2019," *MMWR* 69(46):1736-1742, November 20, 2020, <https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6946a4-H.pdf>. Number of young adult e-cigarette users calculated using 2019 American Community Survey 1-Year Estimates, <https://www.census.gov/programs-surveys/acs>.

Wang, TW, et al., "E-Cigarette Use Among Middle and High School Students – United States, 2020," *MMWR* ePub, September 9, 2020, <https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6937e1-H.pdf>.

²⁴ Wang, TW, et al., "E-Cigarette Use Among Middle and High School Students – United States, 2020," *MMWR* ePub, September 9, 2020, <https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6937e1-H.pdf>.

²⁵ 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>.

²⁶ Wang, TW, et al., "E-Cigarette Use Among Middle and High School Students – United States, 2020," *MMWR* ePub, September 9, 2020, <https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6937e1-H.pdf>.

²⁷ FDA, "Modifications to Compliance Policy for Certain Deemed Products: Guidance for Industry, Draft Guidance," March 13, 2019, <https://www.fda.gov/media/121384/download>.

²⁸ Wang, TW, et al., "E-Cigarette Use Among Middle and High School Students – United States, 2020," *MMWR* ePub, September 9, 2020, <https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6937e1-H.pdf>.

²⁹ Wang, TW, et al., "E-Cigarette Use Among Middle and High School Students – United States, 2020," *MMWR* ePub, September 9, 2020, <https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6937e1-H.pdf>.

³⁰ Miech, R, et al., "Trends in Use and Perceptions of Nicotine Vaping Among US Youth from 2017 to 2020," *JAMA Pediatrics*, published online December 15, 2020.

³¹ Cornelius, ME, "Tobacco Product Use Among Adults — United States, 2019," *MMWR* 69(46):1736-1742, November 20, 2020, <https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6946a4-H.pdf>. Dai, H & Levanthal, A.M, "Prevalence of e-Cigarette Use Among Adults in the United States, 2014-2018," *JAMA*, September 16, 2019, https://jamanetwork.com/journals/jama/fullarticle/2751687?questAccessKey=f449ac04-5797-4d99-9b05-39234c35f47e&utm_source=silverchair&utm_medium=email&utm_campaign=article_alert-jama&utm_content=olf&utm_term=091619.

³² Cornelius, ME, "Tobacco Product Use Among Adults — United States, 2019," *MMWR* 69(46):1736-1742, November 20, 2020, <https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6946a4-H.pdf>. CDC, "Tobacco Product Use and Cessation Indicators Among Adults — United States, 2018," *MMWR* 68(45):1013-1019, November 15, 2019, <https://www.cdc.gov/mmwr/volumes/68/wr/pdfs/mm6845a2-H.pdf>. See also CDC, "Tobacco Product Use Among Adults – United States, 2017," *MMWR* 67(44):1225, November 9, 2018, <https://www.cdc.gov/mmwr/volumes/67/wr/pdfs/mm6744a2-H.pdf>.

³³ Obisesan, OH, et al., "Trends in e-Cigarette Use in Adults in the United States, 2016-2018," *JAMA Internal Medicine*, Online ahead of print, doi: 10.1001/jamainternmed.2020.2817, September 8, 2020.

³⁴ 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.

³⁵ National Academies of Sciences, Engineering, and Medicine (NASEM), *Public Health Consequences of E-Cigarettes*, Washington, DC: The National Academies Press, 2018, <http://nationalacademies.org/hmd/Reports/2018/public-health-consequences-of-e-cigarettes.aspx>. CDC, *Electronic Cigarettes: What's the Bottom Line?*, February 22, 2018, https://www.cdc.gov/tobacco/basic_information/e-cigarettes/pdfs/Electronic-Cigarettes-Infographic-508.pdf.

³⁶ NASEM, *Public Health Consequences of E-Cigarettes*, 2018.

³⁷ CDC, "Dual Use of Tobacco Products." <http://www.cdc.gov/tobacco/campaign/tips/diseases/dual-tobacco-use.html#ten>. Accessed November 19, 2015.

- ³⁸ 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.
- ³⁹ CDC, "Dual Use of Tobacco Products," <http://www.cdc.gov/tobacco/campaign/tips/diseases/dual-tobacco-use.html#ten>, accessed November 19, 2015.
- ⁴⁰ 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%20eciq%20vapor%20this%20time%20slides%202013.pdf>. NASEM, *Public Health Consequences of E-Cigarettes*, 2018.
- ⁴¹ 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. NASEM, *Public Health Consequences of E-Cigarettes*, 2018. 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>.
- ⁴² 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.
- ⁴³ CDC, "Dual Use of Tobacco Products," accessed November 19, 2015, <http://www.cdc.gov/tobacco/campaign/tips/diseases/dual-tobacco-use.html#ten>.
- ⁴⁴ 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>.
- ⁴⁵ NASEM, *Public Health Consequences of E-Cigarettes*, 2018, p. 5-31.
- ⁴⁶ HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: HHS, CDC, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2016.
- ⁴⁷ 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.
- ⁴⁸ FDA, "FDA In Brief: FDA encourages continued submission of reports related to seizures following e-cigarette use as part of agency's ongoing scientific investigation of potential safety issue," August 7, 2019, <https://www.fda.gov/news-events/fda-brief/fda-brief-fda-encourages-continued-submission-reports-related-seizures-following-e-cigarette-use>. FDA, "Statement from FDA Commissioner Scott Gottlieb, M.D., and Principal Deputy Commissioner Amy Abernethy, M.D., Ph.D., on FDA's ongoing scientific investigation of potential safety issue related to seizures reported following e-cigarette use, particularly in youth and young adults," April 3, 2019, <https://www.fda.gov/news-events/press-announcements/statement-fda-commissioner-scott-gottlieb-md-and-principal-deputy-commissioner-amy-abernethy-md-phd>. FDA, "Some E-cigarette Users Are Having Seizures, Most Reports Involving Youth and Young Adults," April 10, 2019, <https://www.fda.gov/tobacco-products/ctp-newsroom/some-e-cigarette-users-are-having-seizures-most-reports-involving-youth-and-young-adults>.
- ⁴⁹ NASEM, *Public Health Consequences of E-Cigarettes*, 2018.
- ⁵⁰ 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>.
- ⁵¹ Marynak, KL, et al., "Sales of Nicotine-Containing Electronic Cigarette Products: United States, 2015," *American Journal of Public Health*, doi:10.2105/AJPH.2017.303660, published online ahead of print March 21, 2017.
- ⁵² 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>.
- ⁵³ 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, "About Electronic Cigarettes (E-Cigarettes)," November 15, 2018, accessed June 24, 2019, https://www.cdc.gov/tobacco/basic_information/e-cigarettes/about-e-cigarettes.html.
- ⁵⁴ 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.
- ⁵⁵ 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/>.
- ⁵⁶ NASEM, *Public Health Consequences of E-Cigarettes*, 2018.
- ⁵⁷ 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.
- ⁵⁸ American Association of Poison Control Centers, "Electronic Cigarette and Liquid Nicotine," <https://aapcc.org/track/ecigarettes-liquid-nicotine>.
- ⁵⁹ American Association of Poison Control Centers (AAPCC), E-Cigarette Devices and Liquid Nicotine, accessed July 13, 2016. Data from 2014-2018 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>.

⁶⁰ 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.

⁶¹ NASEM, *Public Health Consequences of E-Cigarettes*, 2018.

⁶² 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.

⁶³ Hair, EC, et al., "Association between e-cigarette use and future combustible cigarette use: Evidence from a prospective cohort of youth and young adults, 2017–2019," *Addictive Behaviors* 112:106593, 2021.

⁶⁴ Cornelius, ME, "Tobacco Product Use Among Adults — United States, 2019," *MMWR* 69(46):1736-1742, November 20, 2020, <https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6946a4-H.pdf>.

⁶⁵ Coleman, B., et al., "Transitions in electronic cigarette use among adults in the Population Assessment of Tobacco and Health (PATH) Study, Waves 1 and 2 (2013-2015)," *Tobacco Control*, published online April 25, 2018.

⁶⁶ Goniewicz, ML, et al., "Comparison of Nicotine and Toxicant Exposure in Users of Electronic Cigarettes and Combustible Cigarettes," *JAMA Network Open* 1(8):e185937. doi:10.1001/jamanetworkopen.2018.5937, 2018.

⁶⁷ 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>.

⁶⁸ 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. NASEM, *Public Health Consequences of E-Cigarettes*, 2018.

⁶⁹ HHS, Office of the Surgeon General, "Smoking Cessation: A Report of the Surgeon General," 2020 <https://www.hhs.gov/sites/default/files/2020-cessation-sgr-full-report.pdf>.

⁷⁰ United States Preventive Services Task Force, "Interventions for Tobacco Smoking Cessation in Adults, Including Pregnant Persons, Final Recommendation Statement," 2021, <https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/tobacco-use-in-adults-and-pregnant-women-counseling-and-interventions>.

⁷¹ NASEM, *Public Health Consequences of E-Cigarettes*, 2018.

⁷² 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.

⁷³ Hajek, Peter et al., "A Randomized Control Trial of E-Cigarettes versus Nicotine Replacement Therapy," *The New England Journal of Medicine* 380:629-637, 2019.

⁷⁴ Berry, K, et al., "E-cigarette initiation and associated changes in smoking cessation and reduction: the Population Assessment of Tobacco Health Study, 2013-2015," *Tobacco Control* 28(1):42-4, 2019.

⁷⁵ Berry, K, et al., "E-cigarette initiation and associated changes in smoking cessation and reduction: the Population Assessment of Tobacco Health Study, 2013-2015," *Tobacco Control* 28(1):42-4, 2019.

⁷⁶ Chen, R, et al., "E-cigarette Use to Aid Long-term Smoking Cessation in the US: Prospective Evidence from the PATH Cohort Study," *American Journal of Epidemiology*, online ahead of print, doi: 10.1093/aje/kwaa161, July 27, 2020. Pierce, JP, et al., "Role of e-cigarettes and pharmacotherapy during attempts to quit cigarette smoking: The PATH Study 2013-16," *PLoS ONE* 15(9):e0237938, 2020.

⁷⁷ 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 Electronic Cigarette (ECLAT) as tobacco cigarettes substitute: a prospective 12-month pilot study," *PLoS One* 8(6):e66317, 2013.

⁷⁸ 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.

⁷⁹ Weaver, Scott R., et al., "Are electronic nicotine delivery systems helping cigarette smokers quit? Evidence from a prospective cohort study US adult smokers, 2015-2016," *PLoS One* 13(7), July 9, 2018.

⁸⁰ Kalkhoran, S & Glantz, SA, "E-cigarettes and smoking cessation in real-world and clinical settings: a systematic review and meta-analysis," *Lancet Respiratory Medicine* 4(2):116-28, 2016.

⁸¹ Adkison, S, et al. "Electronic Nicotine Delivery Systems: International Tobacco Control Four-Country Survey," *American Journal of Preventive Medicine* 44(3):207-215, 2013.

⁸² Weaver, SR, et al., "Are electronic nicotine delivery systems helping cigarette smokers quit? Evidence from a prospective cohort study US adult smokers, 2015-2016," *PLoS One* 13(7):e0198047, July 9, 2018.

⁸³ NASEM, *Public Health Consequences of E-Cigarettes*, 2018.

⁸⁴ 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>.

⁸⁵ Schane, RE, Ling, PM, & Glantz, SA, "Health Effects of Light and Intermittent Smoking: A Review," *Circulation* 121(3):1518-1522, 2010.

⁸⁶ Tverdal, A and Bjartveit, K, "Health Consequences of Smoking 1-4 Cigarettes per Day," *Tobacco control* 14(5), 2005. Hackshaw, A, et al., "Low cigarette consumption and risk of coronary heart disease and stroke: meta-analysis of 141 cohort studies in 55 study reports," *BMJ* 360:j5855, <http://doi.org/10.1136/bmj.j5855>, 2018.

⁸⁷ Hackshaw, A, et al., "Low cigarette consumption and risk of coronary heart disease and stroke: meta-analysis of 141 cohort studies in 55 study reports," *BMJ* 360:j5855, <http://doi.org/10.1136/bmj.j5855>, 2018.

⁸⁸ 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.