A growing number of adults and youth are using electronic cigarettes, which provide a relatively new way to deliver the addictive substance nicotine without burning tobacco. Many questions remain about the long-term health effects of these products for individual users and about the population-wide effects of these products. It is not clear whether these products will help people quit, discourage smokers from quitting completely, or lead to nicotine addiction and tobacco use for new users, including kids.

What are Electronic Cigarettes?

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

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

While the e-cigarette market was originally dominated by companies whose primary product was e-cigarettes, the three major U.S. tobacco companies – Altria/Philip Morris, Reynolds American/Lorillard and ITG Brands – have now entered the e-cigarette market. There are, however, hundreds of e-cigarette companies and thousands of “vape” shops in the U.S. market, leading to a wide variety of product characteristics, including ingredients and nicotine content. A large proportion of e-cigarettes in the U.S.

* For the purposes of this factsheet, the term “e-cigarettes” will be used to represent the entire category of products.
market are imported. For those that are domestically produced or assembled, certain components and ingredients are still manufactured abroad.4

E-Cigarette Marketing

An investigative report released in April 2014 by 11 members of Congress5 provides some of the most detailed evidence to date that electronic cigarette manufacturers have resurrected the marketing practices used by tobacco companies for decades to attract kids to smoking. These tactics include ads that reach youth audiences; sponsorships and free samples at youth-oriented events such as auto races and music festivals; celebrity spokespeople who depict e-cigarette smoking as glamorous; and sweet, kid-friendly flavors with names like Cherry Crush, Chocolate Treat, Peachy Keen and Grape Mint. The report finds that many of the e-cigarette companies also use social media to promote their products.

Unlike cigarette and smokeless tobacco companies, e-cigarette companies are not currently required to report their marketing and promotional expenditures to the U.S. Federal Trade Commission (FTC), so the exact amount spent to advertise and promote these products is uncertain. However, independent research from Kantar Media released in a report by Truth Initiative shows that e-cigarette advertising expenditures have increased dramatically, from $5.6 million in 2010 to $115.3 million in 2014.6 Other studies have also documented this significant increase in spending.7 These figures likely underestimate the true extent of e-cigarette advertising, as the available marketing data is not comprehensive (e.g., social media and sponsored events—strategies widely used by numerous e-cigarette companies—are not included).

These advertising efforts have effectively reached youth and young adults. The 2014 Youth Tobacco Survey (YTS) found that 68.9 percent of middle and high school students—18.3 million youth—had been exposed to e-cigarette advertisements from at least one source.8 Another recent study found that 82 percent of 12-17 year olds and 88 percent of 18-21 year olds reported seeing e-cigarette advertising in 2015.9 A 2016 study in Pediatrics, analyzing 2014 YTS data, found that exposure to e-cigarette advertising is associated with current e-cigarette use among youth and that greater exposure to e-cigarette advertising is associated with higher odds of use.10

Use of E-Cigarettes is Growing

Sales of e-cigarettes have grown dramatically in recent years, leading Wall Street analysts to project that e-cigarettes could eventually have sales comparable to, or even greater than, cigarettes.11

Adult Use. Data from the National Health Interview Survey (NHIS) show that in 2014, 12.6 percent of adults had ever tried an e-cigarette and 3.7 percent of adults currently used e-cigarettes every day or some days.12 Earlier data from a different survey, released by researchers from the U.S. Centers for Disease Control and Prevention (CDC), found that in 2013, 8.5 percent of adults had used an e-cigarette at least once and e-cigarette use among adults in the past 30 days increased from one percent in 2010 to 2.6 percent in 2013.13

Youth Use. National data released by the CDC and the Food and Drug Administration (FDA) show that youth use of electronic cigarettes exceeds use of cigarettes for the second year in a row, with 16.0 percent of high schoolers1 and 5.3 percent of middle schoolers reporting current use in 2015.14 Since 2011 there has been a ten-fold increase in use among high schoolers (the rate was just 1.5 percent in 2011) and a nearly five-fold increase in use among middle schoolers (from 1.1% to 5.3%).15 Current use is defined as use on at least one day in the past 30 days. Over 2.3 million high school students and 620,000 middle school students currently use e-cigarettes. Since the survey also found that over 1.6 million youth smoke cigarettes, this means that more than 1.3 million current e-cigarette users do not smoke cigarettes.16

† The 2015 Youth Risk Behavior Survey (YRBS), using different methodology than the YTS, found that 24.1% of high school students were current e-cigarette users, compared to 10.8% who were current cigarette smokers. 2015 was the first year that YRBS conducted e-cigarette use surveillance, so trend data are not available.
The same survey found that among those students who had used e-cigarettes in the past 30 days in 2014, 15.5 percent of high schoolers and 11.8 percent of middle schoolers were frequent users of e-cigarettes, using e-cigarettes on at least 20 of the preceding 30 days. This amounts to an estimated 340,000 middle and high school students who were frequent users of e-cigarettes. More than a quarter of high school e-cigarette users had used e-cigarettes on at least six days in the previous month.17

Based on earlier data, CDC researchers also 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 2013.18 These same data for 2015 have not been released for youth. However, the 2014 NHIS data found that nearly 10 percent of 18 to 24 year olds who have never smoked cigarettes had tried an e-cigarette.19

Newly published data from FDA’s 2013-2014 Population Assessment of Tobacco and Health (PATH) survey found that 81 percent of youth aged 12-17 who had ever used e-cigarettes had used a flavored e-cigarette the first time they tried the product, and that 85.3 percent of current youth e-cigarette users had used a flavored e-cigarette in the past month. Moreover, 81.5 percent of current youth e-cigarette users said they used e-cigarettes “because they come in flavors I like.”20 Additional national data from the 2014 NYTS found that 63.3 percent of middle and high school e-cigarette users—totaling nearly 1.6 million youth—had used a flavored e-cigarette in the past month.21

Health and Public Health Concerns

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

E-cigarette ingredients and constituents. There is insufficient research on the long-term effects of using e-cigarettes, which involves regular inhalation of nicotine, glycerin or some other solvent, and other additives.22 According to the CDC, e-cigarette aerosol is not harmless "water vapor" and it is not as safe as clean air.23 E-cigarette aerosol contains nicotine, which is absorbed by users and bystanders.24 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.25 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.26 Because e-cigarettes are not yet regulated by the FDA and are available in hundreds of different brands27, there is no way for consumers to know for sure what is in the products or the aerosol.28

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 designation29 have noted that it applies to ingestion, not for other exposures such as inhalation. Currently, the health effects of inhaling these substances are unknown.30 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.31

Impact of Nicotine. E-cigarettes and refill liquids contain widely varying levels of nicotine. 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.32 Nicotine also impacts the cardiovascular system.33

Several of the products themselves include warnings that inhaled nicotine is "very toxic." Product packaging for at least three e-cigarettes (NJOY, MarkTen, and Mistic) have included warnings that state that nicotine is “very toxic by inhalation.”

Poisoning and Exposure to Liquid Nicotine. Delivered in high doses, nicotine can be lethal. Exposure to liquid nicotine found in

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of calls to poison control centers involving exposures to e-cigarette devices and liquid nicotine.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>271</td>
</tr>
<tr>
<td>2012</td>
<td>460</td>
</tr>
<tr>
<td>2013</td>
<td>1,543</td>
</tr>
<tr>
<td>2014</td>
<td>3,783</td>
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<tr>
<td>2015</td>
<td>3,073</td>
</tr>
<tr>
<td>Through May 2016</td>
<td>770</td>
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</tbody>
</table>
e-cigarettes has caused a burgeoning number of calls to poison control centers. The American Association of Poison Control Centers (AAPCC) reports that there were 3,073 calls involving exposures to e-cigarette devices and liquid nicotine in 2015, a decrease from 2014 but still nearly double the number of calls in 2013. In 2014, more than half of these calls to poison hotlines were to report exposures among children under the age of six.\textsuperscript{34}

\textbf{Dual Use and Cessation}. The currently available data indicate that most e-cigarette users report using both e-cigarettes and cigarettes. A 2013 survey found that the vast majority of current e-cigarette users (77 percent) were also current smokers.\textsuperscript{35} And in 2014, nearly half (47.6 percent) of current smokers reported having ever tried e-cigarettes, with 15.9 percent of smokers reporting that they also currently use e-cigarettes.\textsuperscript{36} The same survey found that 20.3 percent of smokers who had tried to quit smoking in the past year and 22 percent of recent former cigarette smokers (those who quit smoking within the past year) currently used e-cigarettes.

Some e-cigarette users report that they believe that e-cigarettes will help them quit or reduce the number of cigarettes they smoke.\textsuperscript{37} However, there is not enough evidence to conclude whether e-cigarettes are a safe and effective smoking cessation device.\textsuperscript{38} The U.S. Preventive Services Task Force, which makes recommendations about the effectiveness of specific preventive care services after a thorough assessment of the science, recently concluded that "the current evidence is insufficient to recommend electronic nicotine delivery systems for tobacco cessation..."\textsuperscript{39} 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."\textsuperscript{40}

Existing research is limited and provides mixed results about the effectiveness of e-cigarettes in helping current smokers successfully quit. Two randomized controlled trials found that e-cigarettes are moderately effective in helping smokers quit, with rates of cessation with e-cigarettes similar to rates of cessation with NRT.\textsuperscript{41} A 2014 longitudinal study of current smokers found that smokers who used e-cigarettes daily for at least one month were more than six times as likely to have quit smoking than those who never used e-cigarettes or only used them once or twice.\textsuperscript{42} 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.\textsuperscript{43}

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.\textsuperscript{44} Reducing the number of cigarettes smoked is a good thing if it eventually leads to quitting completely. However, e-cigarettes could ultimately reduce the number of smokers who would otherwise quit if smokers continue to use them in addition to, and not instead of, regular cigarettes. This would have a negative impact on public health. Smokers who continue to smoke (even fewer cigarettes per day) but also use e-cigarettes will increase their individual risk if this delays or prevents cessation. Furthermore, CDC has highlighted the importance of quitting cigarettes completely, not just cutting down. According to the CDC, "If you only cut down the number of cigarettes you smoke by adding another tobacco product, like e-cigarettes, you still face serious health risks. Smokers must quit smoking completely to fully protect their health – even a few cigarettes a day are dangerous."\textsuperscript{45}

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.\textsuperscript{46} Several Surgeon General’s Reports and other studies have indicated that the risk of cardiovascular disease and other smoking-related diseases depends largely on the length of time a person smokes, not just the number of cigarettes smoked. Thus, prolonging smoking, despite smoking fewer cigarettes from using e-cigarettes, will continue to put that person’s health at greater risk than if he or she had quit smoking entirely.\textsuperscript{47}

\textbf{Important unanswered questions}:

- As discussed above, instead of replacing cigarettes completely, do e-cigarettes lead to dual use by cigarette smokers by providing a way to satisfy their nicotine addiction in places they cannot smoke?
Electronic Cigarettes: An Overview of Key Issues

• If e-cigarettes continue to be irresponsibly marketed, could they make smoking look glamorous again and undermine decades of work to reduce youth smoking?
• Do e-cigarettes serve as a gateway to nicotine addiction and use of other tobacco products for new users, including kids?
• Do e-cigarettes draw former smokers back into nicotine addiction and potentially back to cigarette smoking?

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

Campaign for Tobacco-Free Kids, June 14, 2016

11 Wells Fargo, Nielsen C-Store Data E-Cig Sales Remain Strong, December 9, 2014.
Electronic Cigarettes: An Overview of Key Issues

45 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
