THE HEALTH AND SAFETY IMPLICATIONS OF E-CIGARETTE USE BY YOUTH

REPORT BY THE COLUMBIA/BOONE COUNTY BOARD OF HEALTH

July 26, 2021

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July 15, 2021

The Columbia/Boone County Board of Health began studying the health effects of adolescent vaping in October 2019 due to community concerns about the steadily increasing proportion of teens affected. The Board reviewed the scientific literature and data from local, state and national youth surveys. We heard from university researchers, anti-tobacco advocates, Columbia/Boone County Public Health and Human Services (DPHHS) staff, school administrators, and members of the Columbia Youth Advisory Council. See list of those who testified on page 7.

The Board sent a letter of concern to the City Council in October, 2019 and the Council requested a report on the subject. After a long hiatus due to the COVID-19 pandemic, the Board finalized the attached, which was drafted by Board member Dr. Leona Rubin.

The key findings of the Board's inquiries are summarized below. We encourage local policymakers including the Columbia City Council, Boone County Commission, and school boards and administrators to consider the information and implement needed policy and program changes. The harmful health and mental health effects of youth e-cigarette use (vaping) are far-reaching, and additional interventions are needed to bring down the number of young people whose lives are marred by nicotine addiction.

1. Vaping harms youth physical and mental health

Nicotine is a significant ingredient in e-cigarettes. Nicotine derived from smoking has well-documented negative health effects on youth, and although the research is still evolving, those effects can also be attributed to nicotine delivered via e-cigarettes.

Nicotine exposure during adolescence can cause addiction and increases the likelihood of smoking traditional cigarettes. Physiological dependence occurs at a much lower level of use than previously thought. Adolescents are more susceptible to the addicting/reward effects of nicotine than adults and are more likely to exhibit an increase in drug-seeking behaviors.

The nicotine in e-cigarettes elicits the same cardiovascular responses as smoking and thus is likely to provoke the same deleterious cardiovascular diseases into adulthood.

Nicotine can harm the developing adolescent brain. Nicotine exposure (in animal models of adolescence) results in deficits in attention and cognition, mood disorders, and increased anxiety and fear disorders, all of which can extend into adulthood.

E-cigarettes and vaping exposes users to many other chemicals known to have adverse health effects. Many are known lung irritants, immunological activators or carcinogens. In 2018-19 a cluster of severe lung damage and multiple deaths was traced to cannabinoid vaping solutions containing Vitamin E oil. Most youth users choose liquids with flavoring ingredients, which when heated and inhaled form dangerous compounds that evoke immune responses, damage lung tissue, and can have estrogenic effects that alter developmental changes during puberty.

Vaping increases the likelihood of viral transmission and COVID-19 infection in youth and increases severity of disease.

The manufacture of e-cigarettes and other electronic nicotine delivery systems is mostly unregulated, and these devices can cause harm through fires, leakage and heavy metal toxicity. Most (90%) are manufactured in China, and many are poor quality counterfeits, difficult to identify and usually cheaper, thus more likely to be used by youth.

2. Youth vaping is a significant problem in Missouri and Boone County

Prior to the pandemic, youth e-cigarette use across the nation more than doubled from 2017-2019. Data collection was difficult during 2020, but CDC recently released the results of the 2020 National Youth Tobacco Survey showing that the national rate of current use among high school students dropped from 27.5% in 2019 to 19.6% in 2020. Among middle schoolers the rate dropped from 10.5% to 4.7%. The reasons for the apparent decline in usage are not clear but probably reflect pandemic disruptions of retail businesses and schools (e.g., masking, social distancing and parental supervision during online schooling). As schools, household routines and the economy return to more normal conditions the rates are likely to increase again.

The 2020 Missouri Student Survey data for Boone County showed that 11.7% of students in grades 6-12 reported using e-cigarettes in their lifetime, and 3.6% reported using them in the past 30 days. However, nearly 90% of Boone County survey respondents were in middle school. Statewide and national data show that e-cigarette usage rates are higher among high school students than middle schoolers, so the lack of data from high school students probably resulted in an underestimate of actual usage rates.

Flavors are a key factor in enticing youth to start vaping. E-cigarettes are sold in over 15,000 flavors, from mint and menthol to gummy bear and cotton candy. According to the 2020 National Youth Tobacco Survey, flavored e-cigarettes were preferred by 85% of high school users and 74% of middle school users in 2020, with fruit and mint flavors the most popular. The 2020 survey also showed a dramatic shift among youth to disposable and menthol e-cigarettes.

Multiple cities around the nation are working toward prohibiting the sale of flavored tobacco products, including vaping fluids. The US Food and Drug Administration (FDA) has been very slow to assess and regulate vaping products. Although prefilled flavored cartridges (except for menthol) were banned by the FDA in 2019, the ban does not apply to refillable vape tanks and delivery devices, or to disposable e-cigarettes, which are increasingly popular among youth.

School policies can reduce student vaping behavior. The Board received information about Columbia Public Schools (CPS) policies that prohibit all nicotine products on campus. We heard from CPS representatives that awareness and enforcement of the policies varied markedly between two of the local high schools, one of which confiscated large numbers of vaping devices while the other seemed generally unaware of vaping violations. Unfortunately, CPS data regarding disciplinary actions did not distinguish vaping from other offenses. We were also given anecdotal reports of high rates of vaping and other tobacco use in rural Boone County schools.

Columbia and Boone County have adopted ordinances prohibiting the sale of tobacco products, including vaping products, to anyone under 21 years of age. The DPHHS hired a Tobacco Education and Enforcement Officer in 2020 to carry out retail compliance audits. The violation rate declined significantly over the

course of 2020, from almost 30% to around 5%, indicating that the compliance program is having a positive effect. See Appendix A.

E-cigarettes are also readily available via the internet, with lax procedures for age verification. We were not able to find data regarding online purchasing, but since other online shopping has increased during the pandemic the same may hold for e-cigarettes. This points to the need additional interventions targeting youth and their parents to increase awareness of the hazards of vaping and especially of counterfeit devices sold online.

3. Additional interventions are needed to reduce teen vaping rates in Boone County

Improve awareness of the hazards of youth vaping through effective parental and youth education. Advertising campaigns and packaging portray vaping as safe and many seem to believe that. Columbia/Boone County DPHHS conducted a grant-funded social media campaign for youth in 2019-20, "Stand Up for Your Health," consisting of posters and ads on SnapChat, Instagram, iheartradio, and Spotify. The theme, researched and tested on youth, was "Don't let the tobacco industry choose for you." The social media advertisements were targeted at people age 13-24 and reached a total of 80,729 individual social media users in 2019 and 104,985 in 2020. Fewer Boone County middle and high school students reported recent use of e-cigarettes after the campaign (3.6% in 2020) than before (9.6% in 2018). The proportion of students who viewed e-cigarettes as harmful rose from 60% in 2018 to 73.5% in 2020. **The Board recommends that this type of social media campaign be funded and resumed with the addition of messaging targeted to parents.**

Continue to actively enforce the Tobacco 21 ordinances and extend them to more Boone County municipalities.

Enforce existing school vaping policies more consistently. Data regarding disciplinary actions should identify vaping violations for comparison across schools, in order to identify problem spots as well as schools that may not be enforcing the policies. Although prevention of use is preferable to discipline for use, vaping should be recognized by all concerned as a "big deal."

Develop model policies and educational interventions for Boone County school districts. The recommended components can be found in the Tobacco Free Kids publication, "How Schools Can Help Students Stay Tobacco-Free," found in Appendix C.

Expand cessation services for youth. Better pathways for addicted youth to receive cessation support are needed. There are high barriers to treatment for youth who are already vaping and little in the published literature about effective vaping cessation programs. There are age barriers to FDA-approved cessation products such as nicotine gum and patches, and online apps and counseling for youth have not been well studied. The Board recommends that the various interested parties in Boone County (MU, CPS and other school districts, health care providers, etc.) continue to monitor treatment developments and collaborate to implement better cessation support as alternatives develop.

Implement stronger policies and ordinances to prevent youth vaping. While Columbia and Boone County have implemented effective policies to reduce youth access to tobacco/vaping products, including Tobacco 21 sales restrictions and tobacco-free campus and workplace policies, youth are still vaping using products purchased by adults. Three additional effective policy interventions have not yet been adopted here.

1. **Zoning restrictions on vape shops.** Vape shops are permitted to operate in close proximity to schools (e.g., directly across the street from Hickman High School), thus normalizing and signaling availability of e-cigarette products to teens. A 2020 assessment of 111 tobacco retail stores in Boone County, performed by the North Carolina-based nonprofit organization Counter Tools, found that two-thirds had exterior advertising and 74.7% of those advertised e-cigarette products (see Appendix B). Retail tobacco sales outlets should be required to be distant from schools (similar to the limitations for pornography shops and marijuana dispensaries).

2. **Prohibit the sale of flavored vaping products.** This has been shown to be an effective intervention. Most youth enter the world of nicotine addiction through flavored products and are less likely to vape if flavors aren't available. Several US cities and states are moving toward such policies in collaboration with the Tobacco Free Kids "Flavors Hook Kids" initiative.

3. **Explore the feasibility of an excise tax on e-cigarettes and other electronic nicotine delivery systems and products.** Many states and local jurisdictions have imposed higher taxes on vaping products to increase the cost and thus reduce use by youth. We recommend the city and county explore this option.

Board of Health Speakers on Youth E-Cigarette Use

10/10/19

Ginny Chadwick, Preventing Tobacco Addiction Foundation

Michelle Shikles, DPHHS Staff

1/9/20

Danielle Mondloch, Substance Abuse Advisory Council

Cassandra Walker-Suggs, Dean of Students, Hickman High School

Brandon Kim, Youth Advisory Council representative Rockbridge High School

Blaine Ravert, Youth Advisory Council representative Hickman High School

Robin Dianics, Ellis Fischel Cancer Center

2/13/20

Dr. Lisa Nieuwenhuizen, Assistant Principal, Rockbridge High School

Dr. Kevin Everett, MU Family and Community Medicine

Health and Safety Implications of E-Cigarette Use by Youth

Introduction and Background

Lighting a cigarette mixes tobacco with oxygen, creating an inhalable smoke containing nicotine, as well as about 7,000 by-products of which ~70 are known to cause cancer. In addition to cancer, it is well established that smoking tobacco increases cardiovascular and respiratory diseases, each of which increase morbidity and mortality for those who partake. Smoking also has detrimental effects on non-smokers through exposure to second-hand or possibly even third-hand smoke. Smoking also negatively impacts fetal development in pregnant women who smoke. Thus, there is considerable effort by medical, public health, and government agencies to stop individuals from smoking tobacco including: prohibiting smoking in indoor public spaces such as restaurants, hotels and public buildings; monetary rewards offered by employers for smoking cessation; and health insurance company motivations through reduced premiums or free coverage for smoking cessation programs. A major challenge to smoking cessation efforts is, and has been, the strong addictive properties of nicotine, a primary component of tobacco and a major driving force for continued tobacco use. Thus, national and regional regulations on the sale and availability of tobacco products have targeted prevention of first-time tobacco use, particularly by youth.

The highly addictive properties of nicotine have led to development of alternative methods to deliver nicotine to the body without the detrimental health outcomes of burning and smoking tobacco, primarily for smoking cessation efforts. Nicotine patches or nicotine gum are available to adults attempting to stop smoking, usually assisted by medical personnel. Consumers, on the other hand, have supplemented or replaced their use of traditional smoking products with electronic nicotine delivery systems (ENDS), which provide the nicotine but without most of the combustible tobacco smoke components. One of the earliest ENDS was an "e-cigarette", invented by the Chinese pharmacist, Hon Lik, in 2003, presumably to assist him with smoking cessation (reportedly unsuccessful). These first-generation e-cigarettes used a piezoelectric heating element to vaporize a propylene glycol solution containing nicotine which the user then inhales. Manufacturers and marketing agencies promote the idea that it is the combustion of tobacco, not the nicotine, that is responsible for most of the health problems associated with smoking, including cancer, heart problems and lung disease, medical authorities disagree. E-cigarettes were first marketed and sold in Asia but soon became available worldwide through internet sales. They were introduced to the American market in 2007 by major tobacco companies seeking an alternative commercial outlet for tobacco products. While the tobacco companies focused on the

Figure 1. Examples of a few of the electronic nicotine delivery devices on the market. These devices continue to evolve in their sophistication and socially acceptable appearance.

extracted nicotine solution, most of the ENDS for delivering the nicotine were, and still are, manufactured in China.

ENDS are quite variable in appearance and size but consist of three main components: 1) a battery, 2) a vaporizing chamber with a heating coil and 3) a cartridge (tank) that contains the volatile liquid. Initially ENDS were designed to look like traditional cigarettes to replicate the visual, sensory, behavioral and social aspects of smoking. These devices were mostly disposable and classified as first-generation e-cigarettes. The second-generation ENDS were larger, the battery became rechargeable (via USB port) and they contained a separate tank that could be replaced or refilled. Third generation ENDS are essential a larger version of the second generation and are called "mods" because they come in a variety of shapes and sizes and the user can customize how much e-liquid is in the tank and how much voltage or power the device can output. The fourth and most recent generation are the most powerful and advanced devices on the market consisting of a stainless-steel cylindrical tank with a temperature regulating system and lower resistance coils that can produce bigger more flavorful vapors. The production of the inhaled vapor by all devices is why the process of using any of these electronic devices is termed "vaping". Examples of some of the mods on the market are shown in Figures 1 and 2.

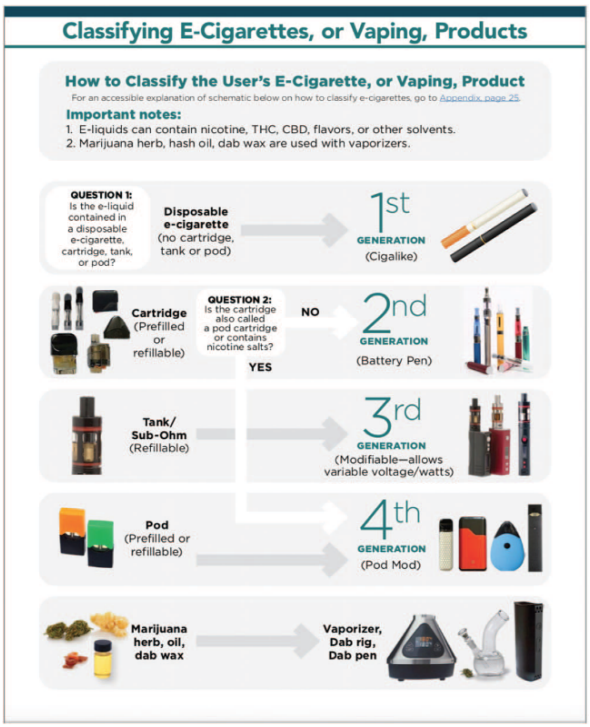


Figure 2. Different types and generations of E cigarettes. Image from the Center for Disease Control and Prevention: E cigarettes, or Vaping, Products Visual Dictionary page 15.

ENDS Marketing

Clearly, ENDS represent a significant and growing consumer market that is expected to gain traction owing to increasing product demand from millennials and an increase in variety of options. ENDS generated $4.2 billion in US sales in 2018, $15.1 billion in 2020, and is expected to generate $18.47 billion in 2021 at a growth rate of 28.1%. By 2028, the industry will generate $104.51 billion in revenue (E-Cigarette And Vape Market Size & Share Report, 2021-2028 (E-cigarette And Vape Market Size & Share Report, 2021-2028 (grandviewresearch.com)). Contributing to this market growth, especially among youth and young adults is 1) the cost-effectiveness of these devices compared to the rising price of traditional cigarettes, 2) addition of flavors 3) youth-targeted marketing, mostly online, with reward programs, subscriptions, and pyramid schemes (called Partner Programs) for online sales, and 4) marketing claims and assumptions that "e-cigarettes" are a safer and healthier alternative to traditional cigarettes. E-cigarettes do contain fewer toxic chemicals, including carcinogens, than cigarettes, so switching could translate to lower rates of smoking-related disease[1]. But it is too simple to look only at "known" carcinogens. It is not yet clear what impact some of the ingredients unique to e-cigarettes could have on health, and the products have not been around long enough for scientists to know how they affect the body over decades.

Nonetheless, surveys of youth and young adults indicate they believe vaping is less harmful than smoking and many do not realize the major ingredient in both is the addictive drug, nicotine [2-4]. Youth and young adults who have never experienced a "smoking world" are particularly susceptible to big tobacco and online retainer marketing methods that appeal to the "being cool", "insider crowd" and "young rebel" mentality of teens [5-7]. Online retailers use names for devices that appeal to youth such as "WTF Target Mini Vaporizer" or a friendly web site name "Vapingpapa.com" that proports to provide user information as well as sales. Online Partner Programs encourage young people to sell ENDS for commissions, usually to other people they know. They simply set up a website or send an email with images and links to a supplier and any visitor to their site, who then purchases from the supplier, earns the original lister a commission. Thus, it is financially beneficial to encourage your friends to shop from your site. **While most web sites indicate you must be of a certain age to purchase, it is unclear how that restriction is managed, and there is little doubt that the marketing of ENDS, from flavors to web-site gimmicks, is directed at a young, new consumer for these products.**

The most comprehensive research and analysis of youth-targeted marketing can be found in a series of articles in Time Magazine by Jamie Ducharme: How Juul Hooked Teens on Vaping and Ignited a Health Crisis | Time, September 19, 2019; and Juul: Inside the Rise and Fall of the Vaping Company | Time, May 17, 2021. Although his work focuses on Juul, all makers of ENDS have adopted the Juul marketing model of making "Vaping" and vaping devices "cool" to the youth market, Juul just had a decade head start on other companies (see Text Box Quote from May 17, 2021 Times article).

Pax—the parent company that made and marketed Juul products—had spent much of its marketing budget on advertisements that appeared in convenience stores and other retail spaces, as well as on the Times Square billboard and in a print ad that appeared in Vice, which called itself part of the "#1 youth media company in the world." But social media marketing was valuable to the scrappy startup too, in no small part because it was cheap. If influencers were seen using the Juul, their followers would want to try it. And once their followers tried it, they would post about it and tell their friends. But this social media marketing strategy, unlike most utilized by startups, hinged on promoting an age-restricted and highly addictive nicotine product on platforms beloved by teenagers.

Juul is now being sued by the attorney general of North Caroline for intentionally targeting teens for sale of its nicotine products and underlying a generation of nicotine addiction by youth. This will be a challenging case in tobacco rich North Carolina. ENDS manufacturers, like Juul, have targeted youth through deployment of flavored nicotine solutions, in addition to MOD design. It is now not surprising that the current Juul website features a headline banner indicating nicotine is addictive and a large photo of a middle-aged couple. Juul now touts itself as a smoking alternative for adults only and effective July 2021 agreed to settle the lawsuit for $40 million. Unfortunately, Juul is only one of many companies and retailers targeting youth and legal age limitations do not appear to prevent youth from obtaining products either in person, from their parents, or online [8, 9].

Federal Regulation of ENDS

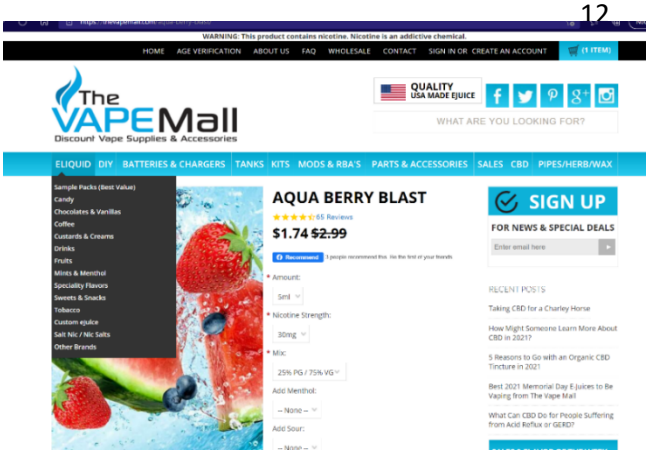
The 2009 Tobacco Control Act gave FDA the necessary tools to reduce society's toll from tobacco, including e-cigarettes. However, the agency has only recently exerted its powers to slow the youth e-cigarette epidemic. Indeed, until very recently, e-cigarette manufacturers enjoyed a market with few barriers. Repeated regulatory delays gave e-cigarette manufacturers more than a decade to

operate with minimal federal oversight. Not until 2016 did the FDA begin to address the e-cigarettes market and request premarket applications (known as PMTAs) to determine whether these new tobacco products are "appropriate for the protection of public health" before they are allowed on the market. Of course, they are already "on the market". After years of delays, in 2017 FDA extended the deadline for completed applications to August 2022. When several public health groups, sued FDA, a federal court ordered the agency to require applications be submitted by September 9, 2020, and FDA has begun reviewing thousands of applications to determine if those products meet the public health standard set by the Tobacco Control Act. While the agency is supposed to conduct its review of those products in one year, FDA's Center for Tobacco Products director has admitted "the likelihood of FDA reviewing all of these applications during the one-year review period is low," foreshadowing yet more delays in necessary and urgent regulatory action. Thus, the products being ingested, inhaled and vaporized into the environment remain unregulated and the impact on youth unknown. Much of this information comes from the 2020 Truth Initiative newsletter focused on youth and e-cigarette regulations (E-cigarettes: Facts, stats and regulations (truthinitiative.org).

Opposing any US government regulation is the lobby group, Sevia USA comprised of Chinese electronic cigarette manufacturers (SeviaUSA). Sevia stands for Shenzhen E-Vapor Industry Association. The companies involved are the leading companies making mostly high quality, innovative vaping devices and products (Aspire, Joyetech, Innokin, Smok, iJoy, Sense, Wotofo, Tesla, and Kangertech). Sevia is lobbying to prevent what they consider to be stifling FDA regulations if it specifies that electronic cigarettes are classified as a tobacco product. Sevia is the largest funder of the Right 2B Smoke Free lawsuit that promotes use of ENDS. Sevia's stated mission is:

1. *The FDA should create a streamlined process that allows companies to submit more reasonable applications for the vapor market.*
2. *Congress SHOULD NOT regulate vapor products as tobacco products, considering these products* ***DO NOT actually contain tobacco leaf.***
3. *The FDA should modify the grandfather date to allow products currently on the market in order to avoid the Pre-Market Tobacco Application (PMTA) process.*

Sevia's membership represents reputable Chinese makers of ENDS, most of which have partnerships with global tobacco companies such as Altria Group, Inc., British American Tobacco, Imperial Brands, Japan Tobacco, Philip Morris International Inc., and R.J. Reynolds Vapor Company which produce the nicotine solution. Partnerships and rebranding between ENDS makers and tobacco companies make it extremely difficult to track ownership and provides even greater opportunities for counterfeiting and cloning of these products. As described below, tobacco leaf should not be the determining factor in whether vaping is classified as a tobacco product, but rather the addictive product of tobacco leaf, nicotine.



The FDA ban on flavored prefilled cartridges (except menthol) during the Trump administration in 2019 will certainly hurt the profit margin of some ENDS companies such as Juul Inc, valued at $38 billion before this ban with $2 billion in 2018 revenue. Unfortunately, many teens and young adults are likely already addicted and willing to jump to non-flavored options or purchase refillable vape tanks, MODS or PODS as **flavored e-liquids were not banned**. For example, the online retailer, The Vape Mall (The Vape Mall: Discount Vaping Supplies, E-Juice & Accessories) allows the buyer to select the e-liquid volume, milligrams of nicotine in that volume, and the flavor (even extra flavor if desired). Thus, it is possible to put 30mg of nicotine into 5ml of solution for nicotine delivery near or exceeding that of traditional cigarettes, and with flavor. Vapor4Life (Best Vape Juice & Cartomizer Flavors | Vapor4life) offers flavors by category, Fruit Flavors, Dessert Flavors, Coffee Flavors, and Beverages (lemonade, orange juice etc). While 5ml of vape juice with 30mg nicotine only cost $1.74, vape tanks ($30-$60), and MODS ($40-$80) are expensive for youth users. Oh, and by the way, the Vape Mall is in Wentzville, Missouri.

Witnessing vaping on TV (for example, Mare of Easttown) and in online advertisements by famous personalities is reminiscent of big Tobacco advertising and adds to the challenges of preventing youth vaping. An FDA warning letter (September 9, 2020) was sent to three ENDS manufacturers to remove their products from the market; *XL Vape LLC* for lack of premarket authorization (deadline for the application was September 9, 2020), and *Flavour Warehouse LTD* (Vampire Vape) and *Pretty Women UK LTD* (Coil2oil Mad Kingdom Liquids) for illegally marketing and advertising e-cigarettes through use of cartoon images (vampires and kings) that appeal to youth. These actions were taken in response to the 2020 National Youth Tobacco Survey demonstrating increased use of disposable e-cigarettes and flavors by youth (National Survey Shows Encouraging Decline in Overall Youth E-Cigarette Use, Concerning Uptick in Use of Disposable Products | FDA). Sadly, as detailed above, the FDA is considerably late in its recognition of the health impact of vaping on our youth and no effort has been made to ban or curtail sale of flavored e-liquids that appeal to youth.

Data on Youth E-Cigarette Use

Each year, the CDC and FDA collaborate, along with local and state health agencies, to implement the National Youth Tobacco Survey (NYTS) (Tobacco Product Use Among Middle and High School Students — United States, 2020 | MMWR (cdc.gov) for high school (grades 9-12) and middle school (grades 6-8) students to gather data on youth tobacco use. The NYTS is a cross sectional, voluntary, school-based, self-administered electronic survey and represents students in public and private schools. The surveys are traditionally conducted in the classroom and starting in 2019 was administered electronically on a tablet preloaded with the questionnaire. A web-based version also exists for students who may have been absent during the survey. According to NYTS data, in 2019, 6.2 million youth used some form of tobacco product. The overwhelming choice for tobacco use was electronic delivery with over 5 million students indicating e-cigarettes use within the last 30 days. One million students said they used e-cigarettes daily and the preferred brand was Juul. The use of e-cigarettes among youth has steadily increased since 2011 while traditional cigarette use

has declined from 16% of high school youth tobacco users in 2011 to 5.8% of users. Middle school students also reported a decline in traditional cigarette use (2011, 4.5% to 2019, 2.3%).

The NYTS for 2020 demonstrated an overall decline in youth tobacco use with 4.47 million students reporting tobacco use within the last 30 days (compared to 6.2 million in 2019). Student use of e-cigarette also declined (3.58 million users) but continued to be the prevalent product choice (**See Info graphic**). Conducting the in-person survey in 2020 was challenging due to the COVID pandemic. Only 50% of the schools selected were available for the survey and the time frame for data collection was reduced from 4 months (Jan 16 thru May 15) to 2 months (ended March 16) due to widespread school closures. However, data was collected from 14,533 students (~50% high school and 50% middle school), only ~3000 fewer than in 2019 and CDC researchers demonstrated with confidence that the change in sampling was not responsible for the overall decline in tobacco use. It would be encouraging if the decline in vaping by youth resulted from public health and school official efforts to educated youth on the dangers of vaping. However, it is also possible this decline is a result of factors associated with the Covid-19 pandemic, such as, reduced retail access, mask wearing in schools and reduced access (6 ft social distance) to the places students tend to congregate and vape, bathrooms and lockers. Interviews with high school students suggest they are knowledgeable of vaping behaviors in their schools [10]. Youth behavior changes due to Covid-19 may underlie some of the reported decline in youth vaping such as avoiding small spaces where aerosol vapers could spread Covid-19 and reduced sharing of ENDS devices among friends which might underlie the increase in disposable e-cigarettes reported in the 2020 NYTS.

ENDS and Youth Health Issues

While the ENDS devices themselves may pose physical harm to youth users, as discussed later in this report, the products they deliver, primarily nicotine, have detrimental effects on health and development of youth users**.** While considerable data exists on the adverse effects of the drug, nicotine, less information is available regarding other components present in vaping solutions or about the vaping process itself. As was true for research with conventional cigarettes and cigarette smoke, the real impact of vaping will require long-term population studies, as well as research with animal models. In addition, our understanding of health effects is somewhat hindered by the variability in vaping components. The concentration of nicotine, presence, or absence of flavorings, and/or the use of other e-liquid constituents contribute to the challenges of assessing the human health risk of vaping. Further, the concentration of aerosolized constituents delivered to the user varies by the type of device and the voltage of the device [11]. For example, commercial vaping products (e-liquids) can contain as little as 0 milligrams/milliliter (mg/mL) to as much as 36.6 mg/mL of nicotine; can be mislabeled [12, 13]; can vary by propylene glycol (PG)/vegetable glycerin (VG) ratio; and, can contain one or more of several thousand available flavorants [14]. Some liquids intended for use in ERMS contain adulterants not even named on ingredient lists [15], and under at least some user conditions, the aerosolization process, which involves heating, produces additional toxicants that may present health risks [16-19]. These issues will be discussed later in more detail. To add to these real and potential health harms is the fact that users of MODS, PODS and tanks can create their own solutions or purchase off-market, black-market solutions, which can have devastating life and death consequences as demonstrated by the multiple deaths associated with vaping tetrahydrocannabinol (THC) dissolved in an oil-base vitamin E solution

[20]. ***It is striking that a substance with so many variables, apparent unregulated content, and such high probability of harm, can reach youth users at all.***

Vaping Solutions with Nicotine

Nicotine is the primary ingredient in most e-cigarettes and ENDS possibly reaching 4% of the volume in e-cigarettes and as high as 6mg/ml in tank refills. Depending on the battery voltage and experience of the person vaping, at least 50% of the solution can be aerosolized. Puff durations of e-cigarette among experienced e-cigarette users may be twice as long (~4 sec) [21-23] as puff duration of conventional cigarettes. Puff duration is causally related to the nicotine content of the e-cigarette aerosol (i.e., the yield or dose) [16]. Thus, a JUUL pod, which contains more than 41mg of nicotine can deliver at least 20mg to the user. While the average pack of conventional cigarettes contains 204mg of nicotine, only about 10% gets inhaled (~20mg total). Thus, some e-cigarettes and ENDS deliver as much nicotine as cigarettes. Given that the primary ingredient in ENDS (so far) is nicotine, and that considerable data already exist demonstrating negative health effects of nicotine, we can assume that regardless of mode of delivery, nicotine will have negative health consequences for youth especially as some e-cigarettes can deliver sufficient nicotine to reach plasma levels comparable to or higher that conventional cigarettes [23, 24]. In fact, the physiological effects of nicotine, whether delivered by conventional cigarettes or vaping, is similar [25]. Thus, at present, a primary concern of health officials regarding e-cigarettes use in adolescence and young is the presence of nicotine.

Nicotine and Youth Addiction Behaviors

Nicotine is the key chemical ingredient that causes and sustains the addicting effects of tobacco products and is the primary ingredient in most e-cigarette solutions. Young people are more sensitive to nicotine than adults and can become dependent on nicotine much faster than adults [26] Preventing Tobacco Use Among Youth and Young Adults:A Report of the Surgeon General (nih.gov) 2016, Surgeon General's Report: E-Cigarette Use Among Youth and Young Adults | CDC. In three independent populations of European origins, early nicotine exposure (younger than 16 years of age), is mechanistically linked to genes associated with the severity of nicotine addiction, and subsequent adult nicotine addiction [27]. The ability of e-cigarettes and e-solutions to deliver comparable or higher amounts of nicotine compared to conventional cigarettes raises concerns about e-cigarette use generating nicotine dependence among young people [28] [29, 30]. The reported blood levels achieved with e-cigarettes likely cause physiological changes to nicotinic acetylcholine receptors in the brain that sustain nicotine addiction in youth [31, 32]. This is particularly concerning for youth and young adults, as early exposure to nicotine increases the severity of future nicotine dependence [30] The Health Consequences of Smoking - 50 Years of Progress: A Report of the Surgeon General (nih.gov).

Animal studies using rodent models demonstrate that the nicotinic acetylcholine receptor pathway is still actively changing during adolescence, with higher expression and functional activity in the forebrain of adolescent rodents compared to adult rodents [33-37]. Rats and mice are among the most commonly used animal models in behavioral neuroscience research. They are well-suited model organisms, as they display a variety of behaviors that are relevant to human behavior and disease. Both perform well in many of the standard neuropharmacalogical tasks, and their size makes it easier to perform more invasive procedures. Mice, and more recently rats, also are amiable to genetic manipulation, an essential tool in neuroscience research, allowing scientists to

investigate the impact of individual genes on development and behavior. Relative to this report, reward-seeking is an easy behavioral measure in rats and this behavior is enhanced by nicotine. Importantly, nicotine enhances the neuronal activity in reward-seeking regions of the rat brain and does so more robustly in adolescent rats than in adults [38-45]. An increased sensitivity to nicotine in the reward-seeking pathways of adolescent rat brains is associated with enhanced behavioral responses for continued administration of nicotine, rats seek out solutions with nicotine. Enhanced nicotine addiction in adolescent rodents compared to adults is supported by considerable behavioral research and highlights the likelihood that human adolescents are particularly vulnerable to developing dependency to and continuing to use nicotine containing e-cigarettes or advance to more conventional cigarettes [46].

Nicotine enhancement of neuronal activity in reward-related regions of the adolescent rat brain also is associated with increased drug-seeking behaviors in general [31, 47] and has been termed "The Gateway Effect" or "Gateway Hypothesis". Multiple studies of adolescent rodents demonstrate that nicotine exposure in adolescence increases the reinforcing effects of other drugs of abuse, including cocaine, methamphetamine, and alcohol, without having a major impact on responding to other rewards (food, play) [44, 48-50]. These studies showed that exposure to even low doses of nicotine for a few days during early adolescence, but not late adolescence or adulthood, increased self-administration of other abused drugs [44, 48, 51-54]. These behavioral changes were associated with alterations in dopamine receptors in regions of the brain known to control impulse behaviors suggesting nicotine exposure during adolescence induces persistent neuronal remodeling of reward-processing centers and potentially enhances the addictive effects of drugs of abuse.

Epidemiological studies of human adolescents suggest use of nicotine in general during high school is a good predictor of current or future drug abuse [54-56]. A recent survey of high school students demonstrated that of the 1 out of 10 (10%) that had vaped cannabis in the last 30 days, a significant majority also used e-cigarettes [57]. The association between drug use and e-cigarettes was stronger than that with other forms of nicotine exposure (chewing, pipe, smoking). This association may be related to the similarity and ease of the delivery mode for both cannabis and nicotine solutions via vaping.

Aerosolized Nicotine and Cardiovascular/Pulmonary Function

Acute administration of nicotine elicits a variety of well-characterized, dose- and route-dependent physiological effects in adults, including alterations in cardiovascular functions, such as increasing heart rate and blood pressure (BP) causing greater cardiac output which leads to an increase in myocardial oxygen demand [58, 59]. Decades of research with cellular models or animal studies has established the biologic underpinnings of nicotine induced physiological changes in both cardiac and vascular tissues and cells [60-63]. Vaping and e-cigarette use elicit similar cardiovascular changes (for review, [64] [65-68] suggesting vaping will elicit similar long-term nicotine mediated morbidity and mortality as other forms of nicotine delivery. A cross sectional study of smokers, non-smokers and sole e-cigarette users demonstrated that vascular stiffness, due to reduced nitric oxide (vasodilator) production was similar for smokers and e-cigarette users [69, 70]. Vascular stiffness is a hallmark of hypertension. Nicotine also induced the production of various inflammatory mediators implicated in the atherosclerotic pathway [66, 71], and at the cellular level, nicotine induces C-reactive protein ((CRP) a marker for inflammation) expression in macrophages that contribute to pro-inflammatory and pro-atherosclerotic effects [72]. Thus,

nicotine, regardless of the mode of delivery is likely to lead to increased blood pressure and future atherosclerotic manifestations in adult and future adults of youth users.

Aerosolized nicotine also elicits detrimental respiratory changes and potential lung damage. Although e-cigarettes do not require inhalation of the combustible product of traditional cigarettes, the aerosolized vapor of e-cigarettes containing nicotine elicited similar respiratory mechanical changes (increased resistance) and increased inflammatory markers in both human and animal studies [73-77]. While findings of increased lung mechanical resistance [78] in e-cigarette users is equivocal, due possibly to different study populations (health vs asthmatic), a common and verified finding is cytokine-dependent lung inflammation due either to the nicotine directly or the solvents present in all nicotine solutions used in e-cigarettes and vaping devices [73, 74]. Nicotine solvents are discussed later.

Long-term population studies, beginning in adolescence, of the detrimental effects of inhalation of nicotine (and solvents) without the combustion products of conventional cigarettes have not been conducted. E-cigarette use is a more recent phenomenon without the decades of research that accompanied conventional cigarette use. However, to date, when e-cigarettes induce a measurable increase in plasma nicotine concentration, they also induce physiological effects similar to conventional cigarettes [79-85] suggesting some of the long-term outcomes of nicotine exposure may well be similar and detrimental.

Nicotine and Brain Development and Cognition in Youth

Brain Development:

There exists considerable scientific evidence to suggest nicotine negatively influences both adolescent and prenatal brain development (for review, USDHHS 2014 The Health Consequences of Smoking - 50 Years of Progress: A Report of the Surgeon General (nih.gov). While there exists limited direct human experimental data regarding the effects of nicotine exposure on the developing adolescent brain, there exists considerable data using animal models that are relevant to human impact and responses [86]. Animal studies offer significant advantages compared to human studies due to better control for confounding factors, and the ability to limit nicotine exposure to differing levels of physical and neural development. Such studies are pivotal for understanding the neural substrates associated with adolescence and nicotine. Using a variety of study designs and research paradigms, research in this area provides convincing evidence for a neuroteratogenic and neurotoxic role of nicotine in the developing adolescent brain [87-89].

The brain is not fully developed at birth and undergoes significant neurobiological development during adolescence and young adulthood, which are critical periods of sensitivity to neurobiological insults [90-95]. Although maturation occurs in different regions of the brain at different rates, a similar process occurs in all areas characterized by the rapid formation of synaptic connections in early childhood, followed by a loss of redundant or unnecessary synapses (called pruning) and the formation of myelin, the fatty sheath that covers and insulates neurons. Myelin allows nerve cells to transmit information faster thus providing for more complex brain processes. Pruning allows for more focused concentration. Both pruning and myelination are important for efficient cognitive processing. The human brain continues to change (plasticity) and adapt throughout life, not only because of normal neural growth and development but also because of changes in environmental neurobiological exposures such as injuries, behaviors, thinking, emotions, and mind-altering drugs such as nicotine [96].

Across species, including humans, adolescence is a key period of increased plasticity and rapid growth of brain circuits that regulate social, emotional, and motivational processes and decision making. During adolescence and into young adulthood, myelination occurs rapidly in the frontal lobe. The prefrontal cortex, which is involved in higher level regulatory control of complex behaviors (executive functioning, planning, reasoning, decision-making skills, self-discipline, and impulse control) continues normal structural and functional development well into young adulthood, to about 25 years of age [97-101]. Because of the immaturity and rapid growth of the prefrontal cortex, adolescents and young adults normally exhibit moody, risk-taking, and unpredictable impulsive behaviors [102-106]. Brain development in juvenile rodents displays patterns that resemble those of human beings, making the rodent model relevant to studying the neurobiological underpinnings of brain maturation in teenagers[107].

Attention and Cognition:

Both cognitive improvements and cognitive deficits have been reported after nicotine exposure in healthy human adults, while smoking during adolescence impairs cognition and attention processes [108-111]. Results of a twin study from the Netherlands Twin Registry indicated a larger increase in attention problems from adolescence to adulthood in twins who smoked compared to their never-smoking co-twins [112]. In another study, adolescent smokers were found to have chronic impairments in the accuracy of their working memory (e.g., in processing information from two sensory modalities simultaneously), which were more severe with an earlier age of onset of smoking [113]. Thus, longitudinal studies in humans provide support for the hypothesis that adolescent use of conventional cigarettes has both acute and long-term effects on attention and memory and appears to be worse when smoking is initiated at a younger age. Although in these studies of nicotine exposure in humans, nicotine cannot be cited as the sole cause of cognitive defects, animal studies have shown that nicotine exposure in adolescent rats induces lasting synaptic changes in the prefrontal cortical regions critical for normal attention, memory, and cognition that likely underlie observed impairments in attentional and cognitive function [114]. In addition, adolescent, but not post-adolescent, rats treated with nicotine demonstrated diminished attention span and enhanced impulsivity in adulthood [115, 116]. The biological causes of these cognitive disturbances (reduced attention span and impulse control) were associated with reduced regulation of synaptic metabotropic glutamate receptor 2 (mGluR2) in the prefrontal cortex [115, 117, 118]. These rodent studies have implications for human adolescents and suggest that exposure to nicotine during youth may lead to long-lasting changes in behavioral and neuronal plasticity into adulthood.

Anxiety and mood disorders:

A meta-analysis showed consistent evidence that both tobacco use and dependence on tobacco products among adolescents increased their risk for anxiety disorders [119]. Other studies demonstrate that early onset of smoking is associated with a shorter time to first onset of an anxiety disorder [120], and there is a positive association between adolescent smoking, particularly through a nicotine pathway, and anxiety in early adulthood [121]. Relationships between adolescent smoking and disruptive disorders (e.g., ADHD; oppositional defiant disorder [ODD] [122] as well as depression [123] also have been reported, while a longitudinal birth cohort found evidence to support a causal relationship between teen smoking and onset of depression [124]. Although these findings are complex and warrant further study using comparisons of genetic polymorphisms associated with smoking or twin and sibling studies [125, 126], they do suggest that nicotine exposure during adolescence could contribute to long-term mental health disorders.

Findings from animal studies support the theory that adolescent nicotine exposure results in long-term alterations in emotional response, specifically enhanced anxiety and fear [127, 128], and in persistent alterations in serotonin systems involved in mediating mood disorders by reprogramming the systems response to nicotine [129]. Even a single day of nicotine treatment in adolescent rats can enhance sensitivity to aversive stimuli later in life and result in a depression-like state in adulthood that is normalized by treatment with nicotine or antidepressants [130]. In summary, given the existing evidence from human and animal studies of the detrimental impact of nicotine exposure on adolescent brain development, the use of nicotine-containing e-cigarettes by youth should be of concern. Both preadolescence and adolescence are developmental periods associated with increased vulnerability to nicotine addiction, and exposure to nicotine during these periods may lead to long-lasting changes in behavioral responses and neuronal plasticity.

Negative Health Effects of Other Ingredients Present in e-Cigarette Solutions

The nicotine used in e-liquids is extracted from tobacco leaf. The extraction process may produce some potentially harmful **tobacco-specific impurities**, including minor alkaloids like nornicotine, anatabine, anabasine, myosmine, cotinine, nicotine-N-oxides (cis and trans isomers), β-nicotyrine, and β-nornicotyrine [131-136]. The correlation between nicotine and the concentrations of minor alkaloids is much stronger in conventional tobacco products [137] than in e-cigarettes [135]. Nonetheless, these alkaloids are present in ENDS solutions and occur at differing concentrations most likely due to poor quality control of e-liquid products during manufacturing and purification [135]. The long-term impact of these alkaloids is unclear.

Propylene glycol (PG) and/or glycerin (VG) are the primary nicotine solvents used in ENDS. Upon heating, PG and VG vaporize to create the nicotine aerosol. PG and CG also decompose under heat to form carbonyl compounds such as the carcinogens formaldehyde and acetaldehyde and the toxic compound, acrolein. The amount of carbonyl carcinogens increases with increasing heat, due to increased device voltage [138-141]. In some devices the temperature near the central coil can reach or exceed 350°C essentially ensuring chemical conversion of PG and VG to harmful levels of carcinogens [142]. Acrolein is a known respiratory and ocular irritant and in animal models plays a role in cancer formation [143-145], production of proinflammatory cytokines [146], development of COPD [147], and progression of atherosclerosis and cardiovascular disease [148-153]. It is unclear if this extreme heat results in production of other harmful compounds since it is not always clear what other components exist in e-cigarette solvents which is for the most part, unregulated.

Negative health effects of **other ingredients** present in vaping solutions are highly probable as many are known lung irritants, immunological activators or carcinogens. Most of these studies have been conducted in animal models or in vitro conditions. In addition, many ENDS, specifically tank models, contain flavorings, which although safe to ingest, have not been studied as aerosols and upon heating have been shown to form significantly dangerous compounds that evoke immune responses and damage lung tissue[154]. Some flavorings also decompose to bioactive drugs [155] and others are estrogenic, potentially altering developmental changes during puberty [156]. Further, package labeling of “other” compounds or ingredients is not required or complete and some flavoring chemicals can reach or exceed 1% by weight in e-cigarettes [157]. Extracts of flavored

vapor solvents lacking nicotine were shown to be cytotoxic on mouse neuronal stem cells and human embryonic stem cells [158]. A partial list of identified, non-nicotine, components found in ENDS solutions is provided below.

Compounds Found in Vapor Solutions	Potential or Known Impact on Health
Cinnamon-related chemicals (CAD, 2-methoxycinnalamdehyde) (flavorings)	Cytotoxic [154], CAD has been used as chemotherapeutic [159], and insecticide [160, 161]
Diacetyl (buttery flavoring)	Decline in respiratory function or obstructive lung disease when inhaled [162, 163]
Acetyl propionyl (flavoring)	Structurally related to diacetyl and inhalation causes airway epithelial damage similar to diacetyl [164]
Tobacco specific nitrosamines (tobacco nicotine extraction process)	Potent human carcinogens [132, 165, 166]
Amino-tadalafil (contaminant?)	Tadalafil is active ingredient in Cialis [155]
Rimonabant (contaminant?)	Weight loss drug removed from the market [155]
Diethyl phthalate (contaminant?) Solvent used in cosmetics, plastics production and aerosol sprays	Estrogenic and antiandrogenic ([136]
Diethylhexyl phthalate (contaminant?) Plasticizer for PVC manufacturing	Estrogenic and antiandrogenic, carcinogenic (IARC) [136]
Heavy metals (tin, lead, nickel, cadmium) (contaminants from the device due to the heating mechanism or poor-quality control)	Heavy metals are known to cause respiratory distress and disease [167-170]
Vitamin E acetate	Lung damage, death [20, 171]
Gamma-butyrolactone (Juul liquid pods)	Industrial solvent used recreationally as a CNS depressant. DEA regulated drug [172]

Effects of ENDS/E-cigarette Use on Oral Health

There is growing evidence from dental research to suggest ENDS vapors cause gum and tissue damages (for review, [173-178]. The formaldehyde that forms in e-cigarette aerosols following the heating of the solvent propylene glycol, is both a gum irritant and carcinogen [179] as are many of the nicotine extraction byproducts [180]. E-cigarette flavorings used in the cartridges induce production of proinflammatory markers and pro-senescence markers in human gingival epithelium and periodontal fibroblasts [181]. The vapors have also been shown to alter the microbiome of the oral cavity [182], change the antibacterial properties of saliva [183] and increase expression of the cisplatin transporter thereby making oral cancer cells more resistant to drug treatment [184]. These changes are highly likely to increase the incidence of gum disease [185] and lead to increases in oral as well as head and neck cancers [186, 187]. Importantly, the impact of e-cigarettes vapors on oral health are worsened by the amount of constituents present, which is directly related to the voltage applied [188] making 3rd and 4th generation e-cigarettes more harmful. Dentists and oral health professionals are in a unique position to try and stem the rise of e-cigarette use among their clients due to its direct effect on the oral cavity [189, 190].

Second-Hand Exposure To Vaping Aerosol

Covid and Other Airborne Illnesses

In response to COVID-19 and the possible association between smoking and illness severity in adults [191, 192] as well as the spread of COVID due to tobacco user behaviors (spitting, exhaling vapors and smoke near others) some countries have banned tobacco sales (notably India and South Africa) [193]or attempted to reduce tobacco and specifically smokeless tobacco use. It is estimated that only 20% of the e-cigarette vapor is actually inhaled with the remaining 80% carried out into the immediate environment. Smoking, spitting of tobacco, vaping, and waterpipe use are likely to increase virus transmission through direct transmission or by generating respiratory or aerosolized droplets (WHO/Europe | Coronavirus disease (COVID-19) outbreak - Resources for tobacco use control as part of COVID-19 response). Thus, youth use of ENDS in bathrooms, classrooms in social situations poses increased risk to other students and staff for viral exposure. A recent study from Stanford University Medical School suggests teens who vape were 5-7 times more likely to get infected with the coronavirus that causes Covid-19 [194]. There could be several reasons for vapers' heightened transmission risk. E-cigarettes can damage lungs and alter the immune system, making each coronavirus exposure more likely to trigger an infection, or the aerosol emitted from e-cigarettes have droplets containing coronavirus. Teens who smoke or use e-cigarettes also are more likely to get seriously ill with COVID-19 although the exact medical/physiological link is unclear [195, 196]. Students are also known to share ENDS and vaping always requires removing the mask. Thus, both smoking and ENDS increases risk of infection and illness in youth users.

ENDS and Youth Safety Issues

The components of ENDS, batteries and heating elements, have potential safety issues that may be more prevalent in young users who are 1) likely to seek less expensive and potentially counterfeit products and 2) less willing or able to recognize certified safety labeling of products. There are conditions under which batteries can short circuit or the battery chemistry can change, causing the ENDS batteries to overheat and vent or explode, potentially causing scalds, flame or contact burns, chemical burns, or blast injuries to the user [197, 198] (US Fire Administration New Report on E-Cig Vape Battery Safety - Levin Simes Abrams). Although sever injury to the face or hands has been reported [199, 200], a recent FDA funded study using data from the National Electronic Injury Surveillance System indicates that of the estimated 1007 injuries in a single year (2016), 80% were thermal injuries, and 77% of these injuries occurred to the upper leg or lower trunk, presumably when the device was located in a pocket. Thus the majority of injuries could potentially be prevented through improved battery design requirements, and/or better battery testing standards. From 2015-2019 there were 3369 e-cigarette related I juries reported to US emergency hospitals suggesting the number of injuries is not declining with improved device manufacturing [201, 202]

When considering the safety and testing standards of electronic products such as ENDS, it is relevant to discuss the manufacturing source for ENDS. Until recently (last 4-5 years), all ENDS were manufactured in the same industrial park in Shenzhen, China. There are reportedly over 600 factories producing ENDS, but only a dozen or so advertise UL Certification of their product (all US products are UL Certified). UL LLC, or Underwriters Laboratories, is a global safety certification company with offices in 46 countries that participates in the safety analysis of new technologies.

A search of the UL website indeed demonstrates that components of vaping devices can and have been UL Certified (E-Cig and Vape Battery and Electrical Certification | UL), specifically the batteries and charging devices. The following statement appears on the UL website regarding vaping devices.

> *"Both electronic cigarettes (e-cigs) and similar vaping devices, often called vap mods, use a rechargeable battery system to power the rapid heating of manufactured consumables. Customized heating elements instantly convert the compatible consumable into a vapor or atomized mist state for inhalation via the user's mouth. Unfortunately, a number of potential failure scenarios including poor mechanical e-cig/vape device design, incompatible battery management system design, operator misuse, or environmental exposures can trigger catastrophic battery failure resulting in fire or explosion. Serious injuries and death have been reported."*

Of the dozen or so Chinese manufacturers that have sought UL Certification, the certification is for a specific product and not every device manufactured by the company may be certified. The first company to seek UL certification was Joyetech, a global ENDS producer, as recently as October of 2018. Thus, most studies and reports of thermal injuries represent non-certified devices and prompted some ENDS manufacturers in China to seek UL certification. ENDS manufactures publicize their UL certification on their website and actively warn consumers against use of counterfeit devices. Counterfeit devices are made to look like the product of a major company and may even exhibit a fake UL certification. However, counterfeit devises are produced more cheaply with inferior batteries and are known to use lower grade metals for their heating coils. Thus, users are potentially exposed to toxic metals in the vapor as well as possible thermal injuries from unstable batteries if they use counterfeit ENDS.

Counterfeiting in the ENDS market potentially represents a billion dollars a year and includes both ENDS devices and cartridges containing liquid product. The most notable occurrence of unregulated and counterfeit vaping solutions occurred in 2018-2020 involving cannabinoid solutions containing Vitamin E acetate [20]. These solutions resulted in severe lung damage (EVALI, e-cigarette or vaping use-associated lung injury) requiring hospitalization of more than 2800 users, mostly youth or young adults, and the death of 68 (2% mortality) as of February 2020. Like many other additives in e-cigarettes, vitamin E acetate may be fine to use externally on your skin and appropriate for oral ingestion but can cause massive destruction of lung tissue when inhaled [171]. Given how easy it is to add ingredients to the tank solution, this will likely not be the last incident of EVALI.

A quick internet search of "counterfeit e-cigarettes" yielded pages of law enforcement reports or lawsuits concerning counterfeit ENDS. Recommendations for identifying counterfeit ENDS include: 1) Price. If it is cheap, it is likely counterfeit. 2) Poor packaging. Most major produces are using high quality, exquisite packaging that corresponds to the product price. 3) Product quality. If parts are loose, scratched or dented, you have a fake. 4) Serial number or Authenticity Code verification. Manufactures have begun etching serial numbers on devices or under package scratch-off sites that can be verified on their website.

Unfortunately, youth are likely active users of and a target for counterfeit ENDS. Youth are more likely to seek less expensive products. They are more likely to buy from online sellers or from friends of friends through pyramid schemes. They are less likely to look for UL codes or authentication codes and even if they find the device to be counterfeit, there is little recourse as devices cannot be returned. Thus, coupled with increased risk seeking or less risk-avoidance behavior, youth are more likely to keep and use a counterfeit device putting themselves in harm's way for possible thermal burns, oral injuries, and health effects associated with inhalation of potentially toxic metals from inferior heating coils.

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CBP, FDA Seize Counterfeit, Unauthorized E-Cigarettes | FDA

www.fda.gov › news-events › press-announcements › c...

Jan 13, 2021 — CBP's trade **enforcement** mission places a significant emphasis on intercepting illicit products that could harm American consumers. In fiscal year 2020, CBP seized 93,590 units of **e-cigarettes** that did not meet U.S. federal **regulations**. In July 2020, the FDA issued a warning letter to Cool Clouds Distribution Inc.

Police Seize More Than 33K Counterfeit E-Cigarettes

www.cspdailynews.com › tobacco › police-seize-more-...

Jan 15, 2021 — U.S. Customs and Border **Police** (CBP) officers seized 33681 **counterfeit e-cigarette** units resembling the Puff Bar brand.

CBP Officers in Chicago Capture $1.5 Million in Counterfeit Vaping Pens | U.S. Customs and Border Protection

March 11, 2021. **CHICAGO–**U.S. Customs and Border Protections officers at Chicago O'Hare's International Mail Branch seized more than 77,000 Rick and Morty Vape Pens on March 9. The shipment, originating from Shenzhen, China, was heading to a distribution company in Georgia.

FDA Seizes $720,000 of Counterfeit and Unauthorised Vapes • VAPE HK

US Customs and Border Protection (CBP), in conjunction with the FDA, have recently seized a shipment of over 33,000 counterfeit and unauthorized e-cigarettes while in transit from China to Texas.

Analysis of Electronic Cigarette Advertisements. *Journal of Medical Internet Research* 2020, **22**(8):e18943.

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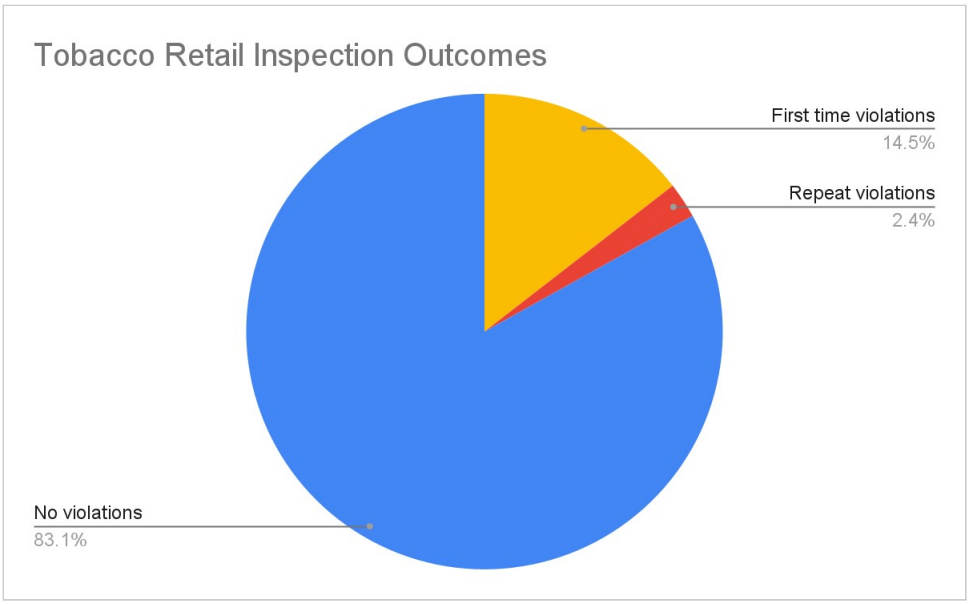
Appendix A

TOBACCO 21 COMPLIANCE PROGRAM 2020 OUTCOMES (6/9/21)

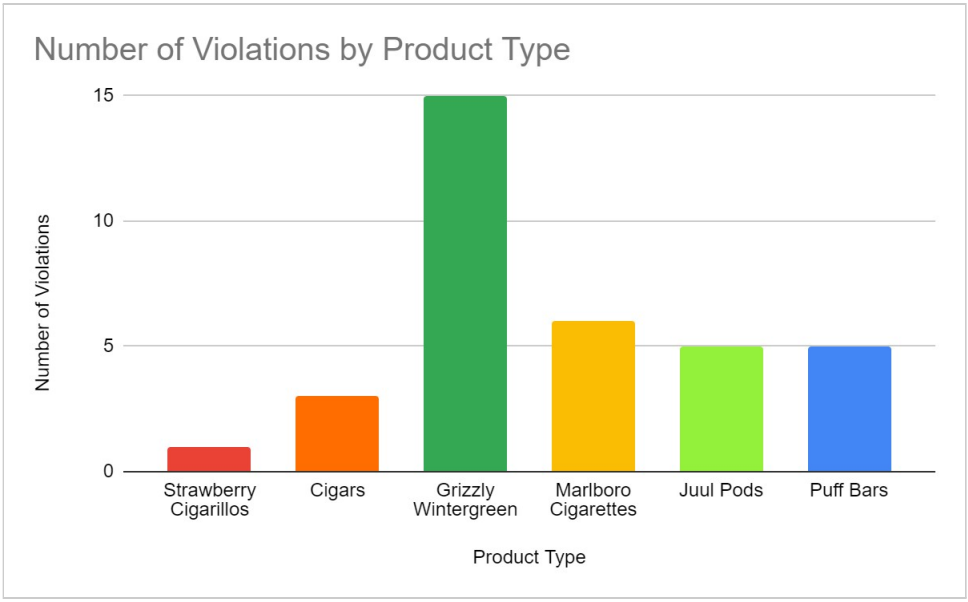
The Tobacco 21 Compliance Program began in January 2020 with an educational brochure and introductory letter which was delivered in standard mail and email to all tobacco retailers in the City of Columbia on file with the Business License Manager in the Finance Department.

After retailers received education and notice that compliance audits would be occurring, PHHS began audits. Compliance audits are conducted with an official youth buyer attempting to purchase any tobacco product. If a purchase is completed, the Tobacco Enforcement and Education Officer issues a violation to the retailer. Violations are sent to the City of Columbia Prosecuting Attorney.

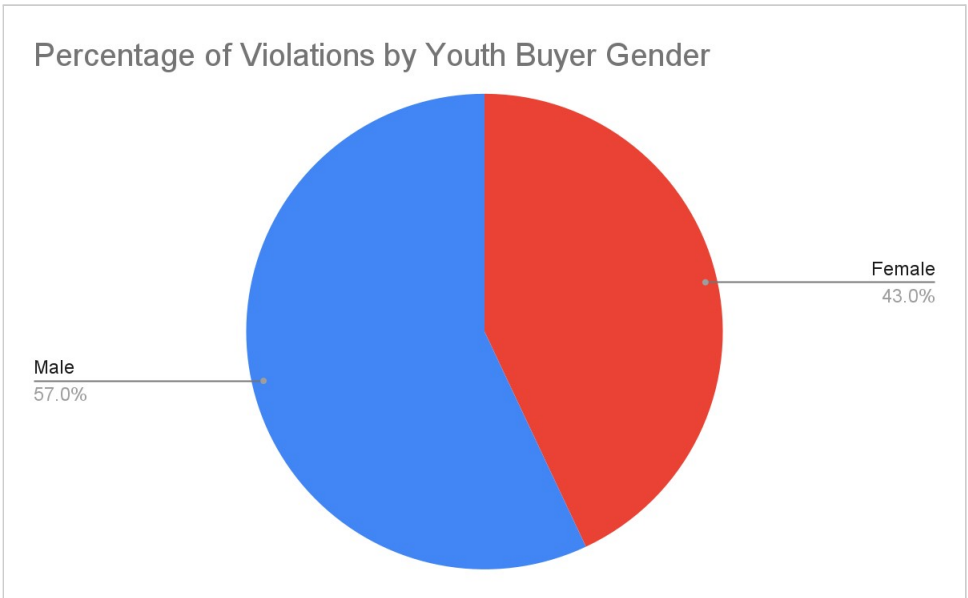
There was a decrease in the violation rate from February to December 2020. No inspections were completed in April and May due to Covid-19 Stay-At-Home Order. The downward trend provides good evidence that the compliance program is effective.



As of December 22, 2020, a total of 207 inspections were completed and 35 violations were issued. Five (5) of the 35 violations were repeat violations. This demonstrates that the vast majority of retailers are compliant and repeat violators are rare.



Youth buyers attempted to make purchases on a variety of products. More violations were made with Grizzly Wintergreen than any other product. Puff Bars are a disposable e-cigarette product.



Youth buyers were aged 18-20. We trained 2-3 new youth buyers every few months. We hired both male and female buyers. Nationally, female buyers tend to have higher violation rates. Locally, 57% of the violations occurred with the purchase by a male youth buyer. We do not have the rate of violations for males and females at this time.

APPENDIX B

Tobacco Retail Store Assessments Boone County, Missouri

January – February 2020

Background

In 2018, Counter Tools and Truth Initiative developed a set of retail tobacco store assessment questions specifically focused on menthol and other flavored tobacco products, building on the Standardized Tobacco Assessment for Retail Settings (STARS) form. This set of questions, called fSTARS, was piloted initially in two cities (Dayton and Cleveland, OH) that are located within Tobacco Nation, a geographic area identified by Truth Initiative as a cluster of states where the smoking prevalence exceeds the national average as well as the prevalence in many of the most tobacco-dependent countries in the world.[i] One factor that contributes to the disparate smoking rates in this region is the lack of tobacco control policies in comparison to the rest of the United States.

The Standardized Tobacco Assessment for Retail Settings (STARS) form was designed for practitioners to inform state and local tobacco control policies pertaining to the point of sale. The STARS form and training materials resulted from a collaboration of SCTC researchers with stakeholders from five state health departments, the CDC, and the Tobacco Control Legal Consortium. The assessment items, which include tobacco product availability, price, promotion, and placement were selected exclusively for their policy relevance. Similarly, Counter Tools and Truth Initiative sought to design and test a set of questions specifically focused on menthol and other flavored tobacco products that had direct policy relevance and that could facilitate localities' consideration of flavor-based policies and other point-of-sale tobacco control policies.

Following the initial pilot in 2018-2019, the form was revised to reflect the evolving market for flavored e-cigarette products, to be able to better compare flavored and non-flavored products, and to compare local data with national trends in disparities in the availability and marketing of flavored products. The revised form was piloted in Columbia and Boone County in 2020, along with two other cities: one within and one outside of Tobacco Nation (Lee's Summit, MO and Evanston, IL, respectively).

Boone County, Missouri has a population of 180,463.[ii] Missouri, part of Tobacco Nation, has the nation's lowest cigarette excise tax at $0.17 and does not yet have a comprehensive smokefree air law statewide.[iii] Missouri's adult smoking rate in 2018 was 19.6%, higher than the national average of 13.7%.[iv] Boone County's adult smoking rate in 2017 was 19%.[v] Boone County's residents are 81.4% non-Hispanic white, 9.8% Black or African American, 5.0% Asian, 3.5% Hispanic or Latino, 0.5% American Indian or Alaska Native, 0.1% Native Hawaiian or Other Pacific Islander, and 3.2% two or more races.[vi] In Boone County, 20.4% of residents are under the age of 18.[vii]

Methodology

Using a list of all tobacco retailers in Boone County, Missouri, provided by Columbia/Boone County Public Health and Human Services, data collectors visited 134 retailers within city limits and were able to complete store assessments at 124 retailers, 111 of which sold tobacco.

Data analysis was completed by Counter Tools. Available store data rather than only complete store data was utilized in analysis; therefore, the total number of assessments summarized for each assessment item may vary depending on the amount of data that was available (or missing) for the particular assessment item.

Tobacco Retailer Types Surveyed (n=111)	
Convenience store with gas	*55.9%*
Convenience store without gas	*4.5%*
Grocery store	*13.5%*
Beer, wine, or liquor store	*8.1%*
Mass merchandiser	*2.7%*
Drug store or pharmacy	*1.8%*
Vape shop	*8.1%*
Tobacco shop	*5.4%*

Retailer Characteristics

- 18 of 110 (16.4%) accepted SNAP
- 19 of 110 (17.3%) accepted WIC
- 97 of 110 (88.2%) also sold alcohol
- 10 of 111 (9.0%) had a pharmacy counter

Convenience stores, which are frequented by youth,[viii] were the most common type of tobacco retailer.

Flavored tobacco products were available for sale at all 110 of 110 (**100%)** retailers surveyed. Youth are more likely to initiate tobacco use with a flavored product. In fact, over 80% of youth who have ever used tobacco started with a flavored product.[ix]

Exterior Advertisements

Exposure to tobacco marketing and advertising contributes to youth tobacco use initiation.[x] Children and adolescents more frequently exposed to point-of-sale tobacco promotion have 1.6 times higher odds of having tried smoking and 1.3 times higher odds of being susceptible to future smoking compared to those less frequently exposed.[xi]

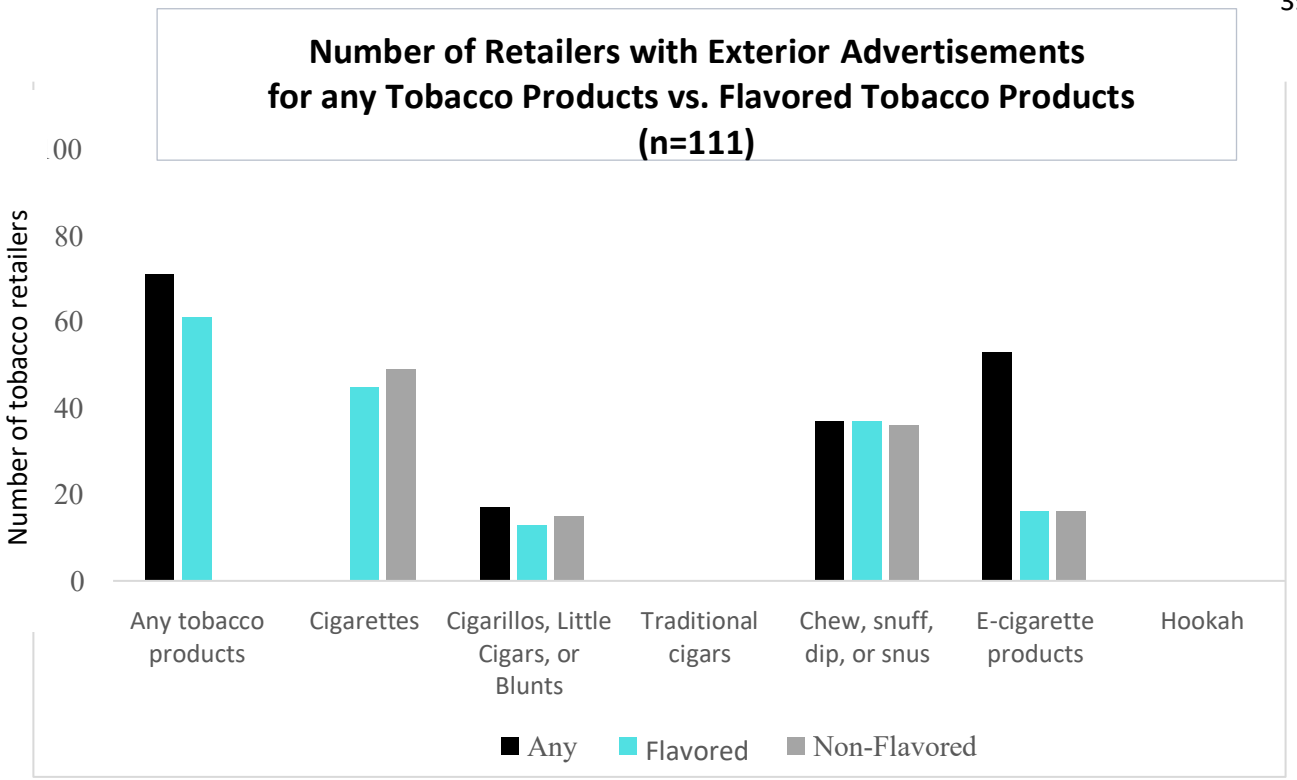
71 of 111 (64.0%) retailers in Boone County had exterior ads for tobacco products.

- 61 of 71 (85.9%) had exterior ads for any flavored tobacco products
- 49 of 70 (70.0%) had exterior ads for non-menthol cigarettes
- 45 of 70 (64.3%) had exterior ads for menthol cigarettes

Exterior Advertisements: Other Tobacco Products

Table interpretation: Of the 71 of 111 (64.0%) of retailers that had exterior ads for any tobacco product, 17 of 71 (23.9%) had exterior ads for cigarillos, little cigars, or blunts. Of those retailers, 13 of 17 (76.5%) had ads for flavored cigarillos, little cigars, or blunts and 15 of 17 (88.2%) had exterior ads for non-flavored cigarillos, little cigars, or blunts. The percentages reported for each assessment item only include stores for which data was available (excludes missing data).

	% of retailers with any exterior tobacco ads n of N (%)	**% of retailers with exterior ads for flavored products** n of N (%)	**% of retailers with exterior ads for non-flavored products** n of N (%)
Cigarillos, little cigars, or blunts	17 of 71 (23.9%)	13 of 17 (76.5%)	15 of 17 (88.2%)
Traditional cigars	0 of 70 (0%)	--	--
Chew, snuff, dip or snus	37 of 71 (52.1%)	37 of 37 (100%)	36 of 37 (97.3%)
E-cigarette products	53 of 71 (74.7%)	16 of 53 (30.2%)	16 of 52 (30.8%)
Hookah	0 of 71 (0%)	--	--



Exterior Advertisements at Retailers Near Schools

When there are more tobacco retailers near schools, youth are more likely to experiment with smoking,[xii] and schools with more retailers within walking distance have higher smoking prevalences than schools with fewer retailers nearby.[xiii]

- 18 of 111 (16.2%) of tobacco retailers surveyed were located within 1000ft of a school.
- 6 of the 18 (33.3%) surveyed retailers located within 1000ft of schools had exterior advertisements for flavored tobacco products, as did 55 of 93 (59.1%) of surveyed retailers located greater than 1000ft away from a school

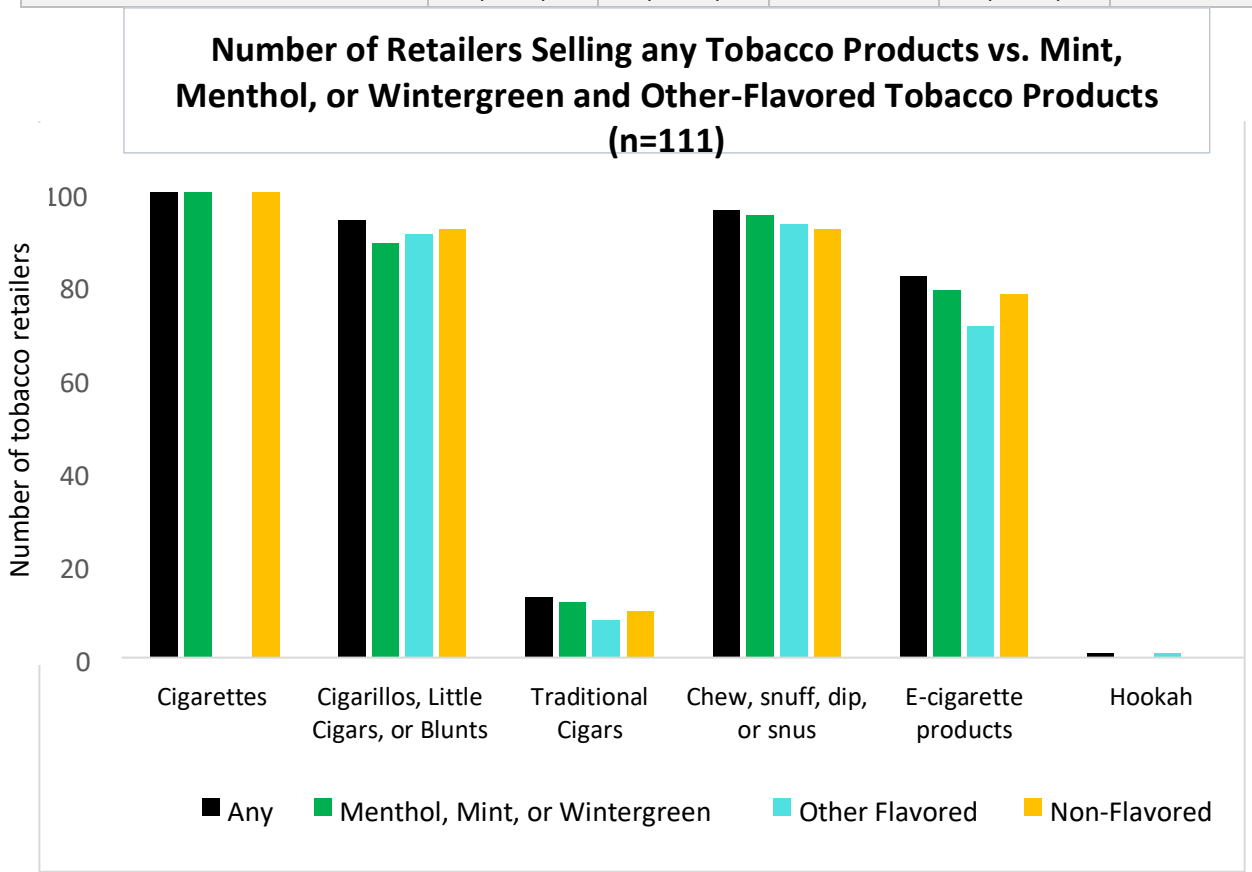
Exterior Advertisements by Neighborhood Demographics

Menthol cigarettes have been disproportionately targeted to African Americans for decades. Marketing for menthol tobacco products is more prevalent in urban neighborhoods and neighborhoods with black residents.[xiv] Neighborhoods with a greater proportion of Black or lower-income residents also have more marketing for little cigars and cigarillos.[xv] While we compared the proportion of retailers with exterior advertisements for menthol cigarettes and the proportion of retailers with exterior advertisements for flavored little cigars, cigarillos, or blunts in census tracts with the least proportion of African American residents to the census tracts with the most African American residents, as well as in census tracts with the most households living below the poverty level to census tracts with the lowest proportion of households living below the poverty level, we are not reporting these percentages. Given the small number of retailers in each tract, we are not able to draw any conclusions about this data.

Product Availability

Table interpretation: 82 of 110 (74.6%) of retailers sold e-cigarettes, of which 80 (97.6%) sold any flavored ecigarettes, 79 (96.3%) sold mint, menthol, or wintergreen flavored e-cigarettes, 71 (86.6%) sold other-flavored e-cigarettes, and 78 (95.1%) sold non-flavored e-cigarettes. The percentages reported for each assessment item only include stores for which data was available (excludes missing data).

Product Sold	**Any** n of N (%)	**Any Flavor** n of N (%)	**Menthol-Flavored** n of N (%)	**Other-Flavored** n of N (%)	**Non-Flavored** n of N (%)
Cigarettes	100 of 110 (90.9%)	N/A	100 of 100 (100%)	N/A	100 of 100 (100%)
Cigarillos, little cigars, or blunts	94 of 110 (85.5%)	92 of 94 (97.9%)	89 of 92 (96.7%)	91 of 92 (98.9%)	92 of 94 (97.9%)
Traditional cigars	13 of 110 (11.8%)	12 of 13 (92.3%)	12 of 13 (92.3%)	8 of 13 (61.5%)	10 of 13 (76.9%)
Chew, snuff, dip, or snus	96 of 110 (87.3%)	96 of 96 (100%)	95 of 96 (99.0%)	93 of 96 (96.9%)	92 of 96 (95.8%)
E-cigarette products	82 of 110 (74.6%)	80 of 82 (97.6%)	79 of 82 (96.3%)	71 of 82 (86.6%)	78 of 82 (95.1%)
Hookah	1 of 110 (0.9%)	1 of 1 (100%)	0 of 1 (0%)	1 of 1 (100%)	0 of 1 (0%)



- Nationally, e-cigarettes are the most common product used by youth, though cigarillos, little cigars, and blunts youth is also growing, particularly among males. Both of these products are often sold in flavors that are appealing to youth, such as candy or fruit flavors.
- Cigarillos, little cigars, and blunts are very widely available in Boone County. While they are just as dangerous as cigarettes, they are sold in a wide variety of flavors that appeal to youth and are often available for less than $1.

Availability of Specific Flavored Tobacco Products

- **Ambiguous flavor names**: 49 of 94 (52.1%) retailers that sold cigarillos, little cigars, or blunts sold them with ambiguously named flavors such as "Tropical Fusion" and "Wild Rush." These flavors can present challenges for enforcement of flavored tobacco restrictions, and may be a tactic the tobacco industry is using to circumvent some definitions of characterizing flavors.
- **Menthol cigarettes:** Menthol cigarettes were widely available in Boone County and sold in all surveyed stores that sold cigarettes.
- **Cigarettes with menthol capsules:** 93 of 100 (93.0%) retailers that sold cigarettes also sold cigarettes with menthol capsules in the filter (e.g. Camel Crush, Marlboro NXT)

A wide range of e-cigarette products are available on the market today. While the first generation of e-cigarettes were disposable and largely looked similar to conventional cigarettes, now newer generations of e-cigarette products come in both disposable and rechargeable varieties. Many are designed with refillable tanks or cartridges designed to be used with flavored nicotine solution or "e-liquid." New 4th generation "pod mod" styles of ecigarettes allow the user to replace cartridges or "pods" that can be refillable or pre-filled with flavored nicotine e-liquid. The pod mod device may be sold separately from the pre-filled pods or together in a "starter kit." These pods also typically use nicotine salts rather than the freebase nicotine used in previous generations of e-cigarettes, which allows the user to easily inhale and absorb high levels of nicotine.[xvi]

This data was collected in between January 24, 2020 – February 21, 2020, during a time when the U.S. e-cigarette market was shifting, and so were youth e-cigarette consumption patterns. E-cigarette use rates among youth have risen to epidemic proportions in recent years, driven largely by the youth-friendly pod mod e-cigarette brand Juul. Juul had captured about 75% of the e-cigarette market in the United States by the end of 2018.[xvii] While the 2020 National Youth Tobacco Survey (NYTS) shows that current e-cigarette use among high school students decreased from 27.5% to 19.6% and current use among middle school students decreased from 10.5% to 4.7%,[xviii] e-cigarettes remain the most common product used by youth. In addition, many youth are vaping frequently, with 22.5% of high school students reporting daily use as well as 9.4% of middle school students.[xix]

In response to the youth e-cigarette epidemic, on January 2, 2020, the FDA announced a federal ban on the sale of flavored pre-filled cartridge-based e-cigarette products (like Juul) other than menthol or tobacco flavor. However, this restriction did not apply to e-liquids used in refillable e-cigarette devices or to disposable e-cigarettes. Retailers were given 30-days to sell off their remaining stock of these newly prohibited products, during which time this data collection began.

Use of menthol-flavored e-cigarette products also grew during this time. Prior to the federal restriction, e-cigarette company Juul voluntarily stopped selling flavors other than menthol and tobacco in retail locations, starting with their fruit- and dessert-flavored pods in October 2018,[xx] and then mint-flavored

pods in November 2019.[xxi] Between August 2019 and May 2020, menthol sales grew from 11% to 52% of total e-cigarette sales.[xxii] While in previous years, menthol was not assessed independently, 2020 NYTS data shows that nearly half of youth and young adults who use e-cigarettes have used a menthol flavored pre-filled pod or cartridge and one quarter have used a menthol flavored disposable vaping product. Sales data also show a shift from mint to menthol.[xxiii]

With the federal restrictions on the sale of flavored e-cigarette products in place, youth consumption shifted to new products like Puff Bar, a disposable e-cigarette that mimicked Juul's design but was still available in sweet and fruity flavors. The 2020 NYTS data show that while pod mods remained the most commonly used type of e-cigarette for 48.5% of high school students, rates of disposable e-cigarette use grew by roughly 1000% among high school students, jumping from 2.4% in 2019 to 26.5% in 2020.[xxiv] In addition, 72.6% of disposable sales were for flavors banned from pod mods, indicating that youth were shifting to these products for the flavors.[xxv] In July 2020, Puff Bar received a warning letter from the FDA instructing the company to remove its products from the marketplace since the product had not received the required premarket authorization,[xxvi] and while the company first declared that they would cease all operations in the United States, they later declared they would only cease online sales in the United States. Puff Bar remains on the market and continues to grow its market share.[xxvii] Other copycat products have also emerged.[xxviii]

Availability of E-Cigarette Products

Product	Availability **n of N (%)**
E-cigarette products (any)	82 of 110 (74.6%)
E-liquid in droppers	7 of 82 (8.5%)
Single disposable e-cigarettes	24 of 82 (29.3%
Pod mods	82 of 82 (100%)
• **Pod mod devices**	76 of 82 (92.7%)
• **Pod mod cartridges**	78 of 81 (96.3%)
• **Pod mod starter kits**	22 of 81 (27.2%)
"Zero nicotine" e-cigarettes	6 of 82 (7.3%)

Tobacco Product Prices

- Of the 94 of 110 (85.5%) of retailers that sold cigarillos, little cigars, or blunts, 79 of 94 (84.0%) sold singles, and 92 of 94 (97.9%) advertised them for less than $1.

$5.79

Avg. Newport Menthol cigarette pack

$3.85

Avg. cheapest non-menthol cigarette pack
Most common brand: Pall Mall

$3.84

Avg. cheapest menthol cigarette pack
Most common brand: Pall Mall

E-Cigarette Product Prices

- Avg. cheapest advertised price of e-liquid (n=7): $7.99 ○ Avg. size of the cheapest dropper of e-liquid: 3.2oz
- Avg. cheapest advertised price for a single disposable e-cigarette (n= 24): $7.99
- Avg. cheapest advertised price for a "pod mod" device (n=76): $3.93
- Avg. cheapest advertised price for a pack of "pod mod" cartridges (n=78): $11.35 ○ Avg. # of cartridges in a pack: 1.7
    - Packs with 1 cartridge: 37 of 69 (53.6%)
    - Packs with 2 cartridges: 24 of 69 (34.8%)
    - Packs with 4 cartridges: 8 of 69 (11.6%) ○ Avg. price per cartridge in the cheapest pack: $6.68
- Avg. cheapest advertised price for a "pod mod" starter kit (n=22): $15.37

Price variation by neighborhood youth population:

- Prices were cheaper on average in neighborhoods with the most youth, who are a more price-sensitive group. The average price of the cheapest pack of cigarettes was $3.94 in census tracts with the lowest proportion (7.44% or less) of households with youth ages 5-17 vs. $3.38 in census tracts with the highest proportion of youth ages 5-17 (18.98% or more)

Price variation by neighborhood income levels:
Lower-income smokers are more likely to purchase discount brand cigarettes.[xxix] However, the average cheapest prices overall were not found in the areas of greatest poverty in Boone County. The average cheapest pack of cigarettes (for both menthol and non-menthol cigarettes) was $4.31 in census tracts with the greatest proportion of households living below the poverty line (38.39% or more), whereas the average cheapest pack of cigarettes was $3.91 and the average price of the cheapest pack of menthol cigarettes was $3.92 in census tracts with the lowest proportion of households living below the poverty

line (6.21% or less). However, the price for a pack of Newport menthol cigarettes was lowest ($5.54) in census tracts with the greatest proportion of households living below poverty, compared to $5.67 in census tracts with the lowest proportion of households living below poverty. Overall, 16.8% of Boone County's residents have household incomes below the poverty line.[xxx]

Price variation by neighborhood racial demographics:
Nationally, research has shown Newport menthol cigarettes to be cheaper in geographic areas with a higher proportion of African American residents.[xxxi] The store assessment results in Boone County, which is 9.8% Black or African American[xxxii], showed this pattern for Newport menthol cigarettes but not for the cheapest pack of menthol cigarettes. The average price of Newport menthol cigarettes was cheaper, at $5.54 in census tracts with the greatest proportion of Non-Hispanic Black residents (14.45% or more), compared to $5.67 in census tracts with both the lowest proportion of non-Hispanic Black residents (2.23% or less). However, the average cheapest advertised price for any pack of menthol cigarettes did not follow this same pattern, with an average price of $4.31 in census tracts with greatest proportion Non-Hispanic Black residents but an average price of $3.92 in census tracts with the lowest proportion of Non-Hispanic Black residents.

Tobacco Product Price Promotions

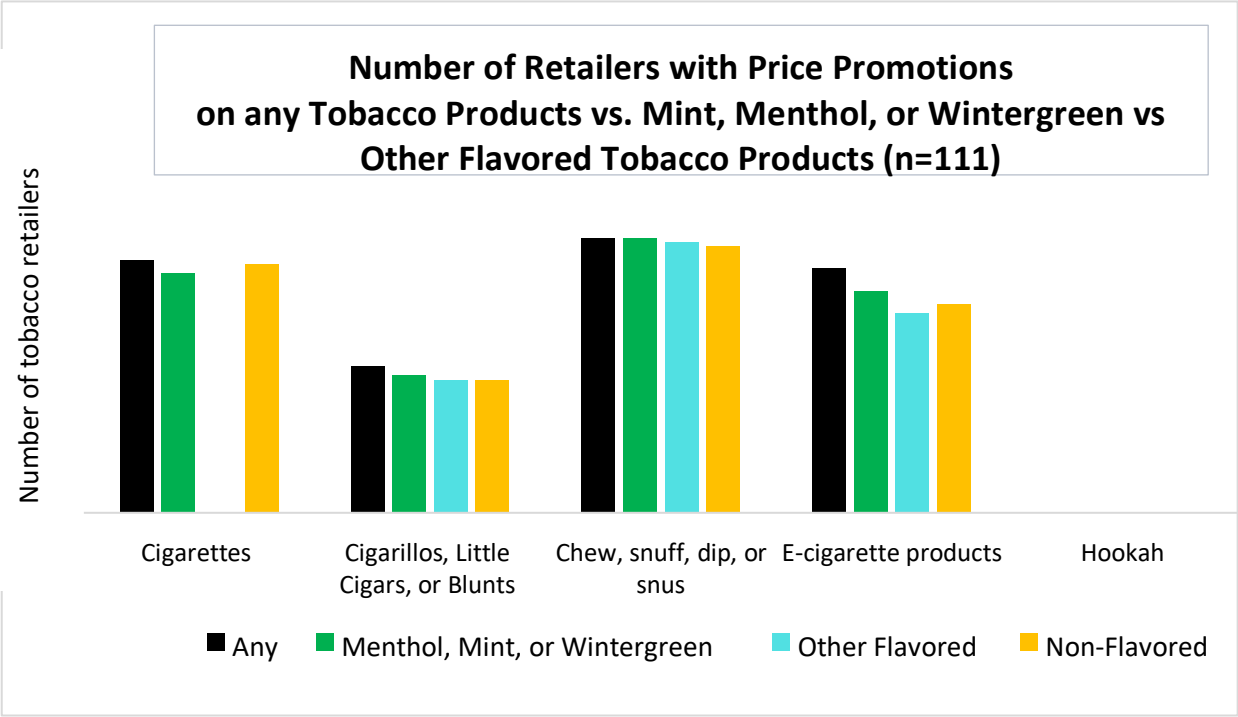
Tobacco companies spent over 85% of their total marketing expenditures for cigarettes and smokeless tobacco in 2018 on price discounts.[xxxiii] Raising the price of tobacco products is one of the most effective strategies for reducing initiation, decreasing consumption, and increasing cessation.[xxxiv] Price promotions and cheap prices can make flavored tobacco products even more appealing to youth and other price-sensitive groups.

Price Promotions

Table interpretation: 55 of 81 (67.9%) retailers that sold e-cigarettes had price promotions on any ecigarettes. 50 of 54 (92.6%) of those retailers had price promotions on mint-, menthol-, or wintergreen-flavored e-cigarettes, 45 of 49 (91.8%) had price promotions on other-flavored e-cigarette, and 50 of 55 (90.9%) had price promotions on any-flavored e-cigarettes, while 47 of 54 (87.0%) had price promotions on non-flavored e-cigarettes. The percentages reported for each assessment item only include stores for which data was available (excludes missing data).

Product	**Any** n of N (%)	**Menthol-Flavored** n of N (%)	**Other-Flavored** n of N (%)	**Any-Flavored** n of N (%)	**Non-Flavored** n of N (%)
Cigarettes	57 of 100 (57.0%)	54 of 56 (96.4%)	N/A	N/A	56 of 57 (98.3%)
Cigarillos, little cigars, or blunts	33 of 94 (35.1%)	31 of 32 (96.9%)	30 of 32 (93.8%)	32 of 32 (100%)	30 of 32 (93.8%)
Chew, snuff, dip, or snus	62 of 96 (64.6%)	62 of 62 (100%)	61 of 62 (98.4%)	62 of 62 (100%)	60 of 61 (98.4%)
E-cigarette products	55 of 81 (67.9%)	50 of 54 (92.6%)	45 of 49 (91.8%)	50 of 55 (90.9%)	47 of 54 (87.0%)
Hookah	0 of 1 (0%)	--	--	--	--

• 17 of 107 (15.9%) retailers surveyed indicated that they accepted mobile tobacco coupons



Product Placement

While cigarettes and smokeless tobacco products are required by federal law to be kept behind the counter, other tobacco products, including flavored products, are often displayed within easy reach of youth without clerk assistance.

Retailers with Tobacco Products in Self-Service Displays

Table interpretation: Of the retailers that sold cigarillos, little cigars, or blunts, 7 of 94 (7.5%) had them in self-service displays. The percentages reported for each assessment item only include stores for which data was available (excludes missing data).

Cigarillos, little cigars, or blunts	7 of 94 (7.5%)
Traditional cigars	4 of 13 (30.8%)
E-cigarette products	3 of 82 (3.7%)
Hookah	1 of 1 (100%)

- 1 of 111 (0.9%) retailers had any tobacco products places within 12 inches of youth products, such as candy, ice cream, soda, or toys.
- 5 of 109 (4.6%) retailers had any tobacco advertisements placed within 3 ft of the floor, right at kids' eye level.

Percent Inventory

Data collectors were asked to estimate the percent of each store's inventory that menthol flavored tobacco products, other-flavored tobacco products, and non-flavored tobacco products each comprised. Across stores in Boone County, data collectors most commonly estimated that:

- Menthol tobacco products comprised 26-50% of the total tobacco inventory • Other-flavored tobacco products comprised 11-25% of the total tobacco inventory
- Non-flavored tobacco products comprised 11-25% of the total tobacco inventory.

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APPENDIX C

HOW SCHOOLS CAN HELP STUDENTS STAY TOBACCO-FREE

Schools are in a uniquely powerful position to play a major role in reducing the serious problem of smoking and other tobacco use by kids. Children spend almost a third of their waking time in school, or about 135 hours per month; and much of the peer pressure kids feel regarding whether or not to use tobacco occurs in school.[1] Nearly 90 percent of adult smokers begin smoking at or before age 18.[2]

A national survey in 2020 found that 2.2 percent of eighth graders, 3.2 percent of tenth graders, and 7.5 percent of twelfth graders had smoked in the past month.[3] Unfortunately, this problem can begin long before high school or even junior high. Though very little data about smoking is regularly collected for kids under 12, the peak years for first trying to smoke appear to be in the sixth and seventh grades (or between the ages of 11 and 13), with a considerable number starting even earlier.[4] In 2015, 3.8 percent of eighth grade students reported having had their first cigarette by the end of fifth grade (ages 10 to 11).[5] If current trends continue, 5.6 million kids under the age of 18 who are alive today will ultimately die from smoking-related disease.[6]

Nicotine is a highly addictive drug; and adolescents, who are still going through critical periods of growth and development, are particularly vulnerable to its effects.[7] Symptoms of serious addiction, which can lead to years of tobacco use and dependence, can appear within weeks or even days after occasional smoking begins.[8] Smoking and other tobacco use causes numerous immediate, sometimes irreversible, health effects and risks that can seriously damage kids' health well before they leave school or reach adulthood.[9]

Because of the addictive power of nicotine, about three out of four teen smokers ends up smoking into adulthood, even if they intend to quit after a few years.[10] Smoking may also be a "gateway" to illegal drug use. Studies show that nicotine addiction often precedes the use of other drugs and is a risk factor for future use of drugs and alcohol.[11]

The Role of Schools in Reducing Youth Smoking and Other Tobacco Use

For schools to effectively prevent and reduce youth tobacco use among their students, they must create an environment that encourages anti-tobacco beliefs and behaviors. This fact sheet offers a brief summary of suggested anti-tobacco policies and programs for schools recommended by the U.S. Centers for Disease Control and Prevention and other youth tobacco prevention experts.[12] For more detailed information, please refer to the cited references.

- ***Forbid tobacco use by students, staff and visitors on all school grounds and at all school- sponsored events.*** School tobacco-free policies that are clearly and consistently communicated, applied and enforced reduce tobacco use among students.[13] While just making sure that no kids use tobacco at school is helpful, also prohibiting tobacco use by teachers, other school staff, and visitors sends a much more powerful and constructive tobacco-free message. And while adopting firm tobacco-free policies for all school properties and events will have a strong positive impact in and of themselves, these policies are even more effective when accompanied by prevention and cessation education.[14] Many schools are already required to prohibit smoking because the Federal Pro Children's Act of 1994 prohibits

smoking in facilities that regularly provide certain Federally-funded children's services.[15]

- ***Provide comprehensive tobacco prevention education.*** School-based education programs to prevent and reduce youth tobacco use work, but they have to be done right.[16] To work best, such programs should comprehensively address all aspects of tobacco use, including the short- and long- term negative health effects, social acceptability, social influences, negative social consequences, peer norms and peer pressure, resistance and refusal skills, and media literacy as it relates to tobacco marketing and advertising.[17] In addition, it is not enough to offer anti-tobacco education only in middle school or early high school. Students should receive this instruction and guidance, in one form or another, throughout their educational experience.[18] Effective youth tobacco prevention programs are grade and age sensitive, with the most intense instruction in middle school and reinforcement throughout high school.[19]

- ***Provide program-specific training for teachers.*** When teachers are trained to properly deliver tobacco prevention curriculum, the success of the overall program is greatly improved.[20] Effective training should include a review of curriculum content, modeling of program activities by skilled trainers and the opportunity for teachers to practice implementing program activities.[21]

- ***Involve parents and families in school efforts to prevent tobacco use.*** Families have an enormous influence on students' tobacco perceptions and attitudes, and family members should be involved in school tobacco-free efforts as much as possible. Programs that include interactive homework assignments that educate and involve parents and other family members not only increase family discussions on this important topic but can lead to better home policies about tobacco use and even encourage adult tobacco users to try to quit.[22]

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- ***Offer interactive tobacco-free projects for students.*** To reinforce the school's tobacco-free policies and strengthen its related programs, schools should offer students opportunities to work on projects to reduce the pro-tobacco influences in their communities. For example, students could do a survey of stores near their school that advertise and sell tobacco products, and then write letters to the store owners urging them to reduce or eliminate their externally visible tobacco-product ads. Similarly, students could start a letter-writing campaign to encourage magazines available in the school library to stop running any tobacco-product advertisements. The Campaign for Tobacco-Free Kids' Kick Butts Day activity guide describes additional anti-smoking projects for students that can be done independently or as part of Kick Butts Day each year: http://www.kickbuttsday.org/.[23]

- ***Help tobacco-using students and staff quit.*** Efforts to reduce tobacco use among school kids must focus on more than just preventing kids from starting. Too many kids already use tobacco products, and these kids need help quitting. Most smokers want to quit smoking. In 2019, nearly half (47.6%) of high school tobacco users tried to quit using tobacco.[24] In 2015, 55.4 percent of adults tried to quit smoking, but only 7.4 percent were successful in staying quit for six months or more.[25] Schools can improve these quitting percentages by providing effective cessation assistance to their students and staff who use tobacco. If school-run cessation programs are not possible, schools can still provide students and staff with information on how to quit and on how to link up with community-based cessation programs—or even bring program representatives to the schools. If there is a shortage of available cessation programs, schools can play an important

role in developing new ones by partnering with community health, youth, and other volunteer organizations. In any such efforts, schools should be mindful of the fact that successful cessation approaches differ for kids and adults. Cessation programs for adolescents, for example, should focus more on immediate consequences, offer specific attainable goals, and use contracts that include rewards.[26]

- ***Adopt a firm school policy of not accepting any funding, curricula or other materials from any tobacco company.*** Tobacco companies produce and market incredibly harmful and addictive products, and they rely on kids to replace their adult customers who die or quit. For that reason, schools should be completely off limits to tobacco companies. But the major cigarette companies still try to get schools to accept all sorts of assistance—like book covers, industry sponsored tobacco prevention curricula and "anti-youth-smoking" funding books—as part of their much broader public relations and political strategies. Some schools say that the only way they can offer tobacco prevention programs and materials to their students is by taking these tobacco-company "gifts." Yet, in many cases, the schools have not even tried to find or develop alternative sources of income or assistance. Regardless, accepting tobacco company funding and materials always benefits the tobacco companies a lot more than the school, and it's always a bad deal for our kids.[27]

- ***Evaluate the school's tobacco-free programs at regular intervals.*** Schools should regularly evaluate their success at implementing smoke-free policies, programs and curriculum components, as well as their success at decreasing students' tobacco use. Such evaluations are necessary for schools to determine which areas of their program need improvement, as well as to demonstrate the positive effects of the program to students, parents and the community, as well as to other schools who have not adopted tobacco prevention programs.

By taking some or all of these steps, schools can have an enormous impact on the current and future health and well-being of their students.

Campaign for Tobacco-Free Kids, December 16, 2020

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