

**Public Health Emergency Needing Action Now:
Epidemic Youth Use of E-cigarettes**

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Submitted to the U.S. House of Representatives, Labor-HHS-Education Appropriations
Subcommittee, Congressional Hearing, *E-Cigarettes: An Emerging Public Health Threat*

Congresswoman Rosa DeLauro, Chair

October 16, 2019

I thank you for the opportunity to provide written and oral testimony on this important and urgent topic, youth e-cigarette use. As a developmental psychologist with additional training in adolescent and young adult health, my research, prevention, and policy work over the past 25 years has focused on factors promoting and preventing adolescent and young adult tobacco use. In my testimony, I will provide data on youth use of tobacco including e-cigarettes, health and social effects of e-cigarettes, risk factors for use, significant gaps in our knowledge, and needed policy, prevention, and cessation efforts.

Tobacco Usage Rates

We have seen a decline in youth use of conventional, combustible cigarettes over the past few years, with national data showing that far fewer than 10% of youth in the

US report use of cigarettes.¹ However, since 2014, we have seen an alarming increase in youth tobacco use, owing to e-cigarette use. The most recent data from the National Youth Tobacco Survey show that 27.5% of youth have reported using an e-cigarette in the past 30 days.² This translates to more than 1 in 5 high school students using e-cigarettes. Those who do use e-cigarettes do so more frequently than other tobacco products, in part because youth are able to use e-cigarettes all day and night.

However, I would argue that these statistics are vastly underestimated. I go around the country speaking to students, parents, and educators, all of whom tell me that **50%-75% of the students are using e-cigarettes**. In my 25 years of studying adolescent tobacco use, I have never seen such a quick surge in tobacco product use and related addiction outcomes as I have seen in the past 3 years. This surge, as explained below, is largely due to the increase in popularity of JUUL,³ which controls 70-80% of the e-cigarette market.⁴ We have also seen an uptick in the number of youth reporting cigarette use^{5,6,7} and overall tobacco use,⁸ likely due to numerous studies showing that youth who use e-cigarettes are as much as four times more likely to then go on to use

¹ <https://www.cdc.gov/vitalsigns/youth-tobacco-use/>

² <https://www.fda.gov/tobacco-products/youth-and-tobacco/youth-tobacco-use-results-national-youth-tobacco-survey>

³ McKelvey, K., Baiocchi, M., **Halpern-Felsher, B.** Adolescents' and young adults' use and perceptions of pod-based electronic cigarettes. *JAMA Netw Open.* 2018 Oct 05;1(6):e183535. PMID:30646249.

⁴ LaVito A. Popular e-cigarette Juul's sales have surged almost 800 percent over the past year. <https://www.cnbc.com/2018/07/02/juul-e-cigarette-sales-have-surged-over-the-past-year.html>. Published July 2, 2018. Accessed August 10, 2018.

⁵ Berry KM, Fetterman JL, Benjamin EJ, et al. Association of Electronic Cigarette Use With Subsequent Initiation of Tobacco Cigarettes in US Youths. *JAMA Network Open.* 2019;2(2):e187794-e187794

⁶ Soneji S, Barrington-Trimis JL, Wills TA, et al. Association between initial use of e-cigarettes and subsequent cigarette smoking among adolescents and young adults: a systematic review and meta-analysis. *JAMA pediatrics.* 2017;171(8):788-797

⁷ Chaffee BW, Watkins SL, Glantz SA. Electronic cigarette use and progression from experimentation to established smoking. *Pediatrics.* 2018 Mar 5:e20173594

⁸ <https://www.cdc.gov/vitalsigns/youth-tobacco-use/>

cigarettes,^{9,10,11} placing them at risk for the same smoking-related illnesses and costs we have strived so hard to ameliorate.

Importantly, unlike recent data seen for cigarette, smokeless tobacco use, or cigar use, there is **no sociodemographic characteristic** or cluster of characteristics putting youth at more or less risk for e-cigarette or Juul use. That is, **there is no difference in Juul or e-cigarette use among adolescents based on sex, race/ethnicity, socioeconomic status, or geographic region.**¹²

Why I am concerned about e-cigarettes?

E-cigarettes have **nicotine**. While the original and earlier versions of e-cigarettes didn't have as much nicotine, with ranges between 0-36 milligrams per milliliter, the newer pod-based products, made popular by Juuls, have at least 41 milligrams per milliliter of nicotine. That translates into the amount of nicotine found in up to 1.5 to 2 packs of cigarettes.

It is important to discuss Juul's patented salt-based nicotine. Unlike cigarettes and other e-cigarette products which use ammonia and sugars to enhance the delivery and absorption of nicotine to the body, Juul has a salt-based nicotine. Benzoic acid is added to help deliver high amounts of nicotine rapidly and effectively to the brain.

Products with salt-based nicotine can allow for more frequent use, increasing their

⁹ Berry KM, Fetterman JL, Benjamin EJ, et al. Association of Electronic Cigarette Use With Subsequent Initiation of Tobacco Cigarettes in US Youths. *JAMA Network Open*. 2019;2(2):e187794-e187794

¹⁰ Soneji S, Barrington-Trimis JL, Wills TA, et al. Association between initial use of e-cigarettes and subsequent cigarette smoking among adolescents and young adults: a systematic review and meta-analysis. *JAMA pediatrics*. 2017;171(8):788-797

¹¹ Chaffee BW, Watkins SL, Glantz SA. Electronic cigarette use and progression from experimentation to established smoking. *Pediatrics*. 2018 Mar 5:e20173594

¹² Kann L, McManus T, Harris WA, et al. Youth risk behavior surveillance—United States, 2017. *MMWR Surveillance Summaries*. 2018 Jun 15;67(8):1

potential for addiction because it feels less harsh on the throat. As such, Juul is engineered to easily deliver more nicotine to the brain, faster, with less harshness, making it more appealing for youth.

Nicotine is harmful. Aside from being a toxicant, nicotine is highly addictive. It actually causes changes to the brain chemistry.¹³ Given that brain development continues until the age of about 25, youth are significantly more likely to become addicted to nicotine than are adults. Data going back decades has shown that almost 90% of addicted adult cigarette smokers started using when they were younger than 18.¹⁴ Indeed, data as well as my personal experience from visiting with parents and schools throughout the country show that youth are addicted to e-cigarettes, with recent studies showing that youth who use Juuls use them more often and are more likely to show signs of addiction than youth using other tobacco products.¹⁵ Nicotine addiction is also related to depressive disorders and other mental health co-morbidities.^{16,17,18} Other effects of nicotine include poisoning and toxicity, vomiting, nausea, and tachycardia.¹⁹ We also know that there has been a significant increase in the number of calls to poison centers, as babies and children consume the e-liquid as it tastes and smells like candy.

¹³ Kandel ER, Kandel DB. A molecular basis for nicotine as a gateway drug. *New England Journal of Medicine*. 2014;371(10):932-943

¹⁴ <https://www.cdc.gov/vitalsigns/youth-tobacco-use/>

¹⁵ McKelvey, K., Baiocchi, M., **Halpern-Felsher, B.** Adolescents' and young adults' use and perceptions of pod-based electronic cigarettes. *JAMA Netw Open*. 2018 Oct 05;1(6):e183535. PMID:30646249.

¹⁶ King JL, Reboussin BA, Spangler J, Ross JC, Sutfin EL. Tobacco product use and mental health status among young adults. *Addictive behaviors*. 2018;77:67-72

¹⁷ WHO. ICD-11 for mortality and morbidity statistics. World Health Organization. Published 2018. Accessed April 22, 2019.

¹⁸ APA. *Diagnostic and statistical manual of mental disorders*. . Fifth Edition ed. Arlington: American Psychiatric Publishing; 2013.

¹⁹ Cameron JM, Howell DN, White JR, Andrenyak DM, Layton ME, Roll JM. Variable and potentially fatal amounts of nicotine in e-cigarette nicotine solutions. *Tobacco control*. 2014 Jan 1;23(1):77-78

Use of e-cigarettes has also been associated with impaired blood vessels, increasing the risk of heart attacks²⁰ and progression of cancerous tumors.²¹

However, youth are unaware of the amount of nicotine in a Juul pod, and don't recognize the addictive potential or harm of nicotine found in Juuls or other e-cigarettes.²² This confusion is not surprising given that the Juul packaging simply says that the product contains 5% strength, and some saying 5% nicotine, but to a young person and even many adults, that 5% does not translate to the actual amount of nicotine contained within the Juul pod.

I also worry about the **other chemicals found in e-cigarettes**. E-cigarettes have flavorants such as diacetyl, a buttery flavor found in popcorn, as well as vanillin and cinnamaldehyde. These have been shown to cause respiratory, lung, and other illness and effects,^{23,24,25,26} as well as recent evidence that mint and menthol flavored e-cigs have pulegone, a carcinogen.²⁷ Further, Juuls have benzoic acid, which can irritate the

²⁰ Alzahrani T, Pena I, Temesgen N, Glantz SA. Association between electronic cigarette use and myocardial infarction. *American journal of preventive medicine*. 2018;55(4):455-461

²¹ Sanner T, Grimsrud TK. Nicotine: carcinogenicity and effects on response to cancer treatment—a review. *Frontiers in oncology*. 2015;5(196)

²² McKelvey, K., Baiocchi, M., **Halpern-Felsher, B.** Adolescents' and young adults' use and perceptions of pod-based electronic cigarettes. *JAMA Netw Open*. 2018 Oct 05;1(6):e183535. PMID:30646249.

²³ Lee, W. H., Ong, S.-G., Zhou, Y., Tian, L., Bae, H. R., Baker, N., ... Wu, J. C. (2019). Modeling Cardiovascular Risks of E-Cigarettes With Human-Induced Pluripotent Stem Cell–Derived Endothelial Cells. *Journal of the American College of Cardiology*, 73(21), 2722–2737. <https://doi.org/10.1016/j.jacc.2019.03.476>

²⁴ Fetterman, J. L., Weisbrod, R. M., Feng, B., Bastin, R., Tuttle, S. T., Holbrook, M., ... Hamburg, N. M. (2018). Flavorings in Tobacco Products Induce Endothelial Cell Dysfunction. *Arteriosclerosis, Thrombosis, and Vascular Biology*, 38(7), 1607–1615. <https://doi.org/10.1161/ATVBAHA.118.311156>

²⁵ Glynos, C., Bibli, S.-I., Katsaounou, P., Pavlidou, A., Magkou, C., Karavana, V., ... Papapetropoulos, A. (2018). Comparison of the effects of e-cigarette vapor with cigarette smoke on lung function and inflammation in mice. *American Journal of Physiology-Lung Cellular and Molecular Physiology*, 315(5), L662–L672. <https://doi.org/10.1152/ajplung.00389.2017>

²⁶ Madison, M. C., Landers, C. T., Gu, B.-H., Chang, C.-Y., Tung, H.-Y., You, R., ... Kheradmand, F. (2019). Electronic cigarettes disrupt lung lipid homeostasis and innate immunity independent of nicotine. *The Journal of Clinical Investigation*, 129(10), 4290–4304. <https://doi.org/10.1172/JCI128531>

²⁷ Jabba SV, Jordt SE, Risk Analysis for the Carcinogen Pulegone in Mint- and Menthol-Flavored e-Cigarettes and Smokeless Tobacco Products. *JAMA Intern Med*. 2019 Sep 16. doi: 10.1001/jamainternmed.2019.3649. [Epub ahead of print]

lungs, nose and throat, and cause coughing and shortness of breath. The levels of secondhand exposure vary across e-cigarette devices; however, bystanders may inhale up to 1/10th the levels of nicotine and aerosol as in a conventional cigarette.²⁸ **Taken together, aside from the current concern over the vaping-related lung illnesses and deaths that may or may not be caused by nicotine e-cigarettes, there is clear evidence that e-cigarettes do cause lung as well as heart and other health problems.**

It is also important to note that the e-cigarette companies are often misleading consumers and potential consumers as to what ingredients are in their products. For example, while Juul indicates that their e-liquids contains nicotine, benzoic acid, glycerol, propylene glycol, natural oils, and flavorants, an independent scientific study showed that there were 59 chemicals in Juul e-liquid.²⁹

There is also concern about the **impact of e-cigarette use on non-using students**. I am constantly told by youth and educators that the non-using students are frustrated by the constant disruptions of students using e-cigarettes, the needed disciplinary actions needed, and the stigma now placed on students **not** using.

Why are youth using e-cigarettes?

There are a number of reasons why youth are attracted to using e-cigarettes. I will focus on **flavors, marketing, and cost**. There are over 7,000 **flavors** available for e-cigarettes, including flavors that attract young and new users, such as mint, menthol, fruit, and candy. These flavors appeal to new users by masking the harsh taste of

²⁸ Grana R, Benowitz N, Glantz SA. E-cigarettes: a scientific review. *Circulation*. 2014;129(19):1972-1986

²⁹ <https://pubs.acs.org/doi/10.1021/acs.chemrestox.8b00381>

tobacco, and in the case of e-cigarettes, resulting in a more pleasant smell than that found with tobacco alone.³⁰ The vast majority of youth in the US who use e-cigarettes initiate with flavored products, namely fruit and mint/menthol.³¹ Adolescents are more likely to report interest in trying an e-cigarette from a friend if it is menthol/mint-, candy-, or fruit-flavored than if unflavored. Most youth e-cigarette users reported they would quit if flavors were unavailable.^{18,19,20,21,22,23} Flavored (vs. unflavored) e-cigarette ads elicit greater appeal and interest in buying and trying e-cigarettes; and the appeal of ads marketing flavors is linked to rapid and persistent adoption of e-cigarettes among youth.^{32,33,34,35,36,37}

Cost. Youth are extremely price sensitive. Yet, the tobacco products youth use most, e-cigarettes, are often LESS expensive than other tobacco products including e-cigarettes. If we increase their price, through taxes on par with other tobacco products, we will reduce youth use.

Marketing of e-cigarettes is of major concern. Trendy, technologically-savvy, relaxed, sexualized words and images are used to advertise e-cigarettes, including Juul.

³⁰ Brown JE, Luo W, Isabelle LM, Pankow JF. Candy flavorings in tobacco. *N Engl J Med*. 2014;370(23):2250-2252.

³¹ McKelvey, K., Baiocchi, M., Halpern-Felsher, B. Youth Say Ads for Flavored E-liquids are for Them. *Addictive Behaviors*, in press.

³² Liang Y, Zheng X, Zeng DD, Zhou X. Impact of flavor on electronic cigarette marketing in social media. 2015;278-283.

³³ Vasiljevic M, Petrescu DC, Marteau TM. Impact of advertisements promoting candy-like flavoured e-cigarettes on appeal of tobacco smoking among children: An experimental study. *Tob Control*. 2016;25(e2):e107-e112.

³⁴ Ambrose B, Day H, Rostron B, et al. Flavored tobacco product use among us youth aged 12-17 years, 2013-2014. *J Am Med Assoc*. 2015;314(17):1-3. doi:10.1001/jama.2015.13802.

³⁵ Pepper JK, Ribisl KM, Brewer NT. Adolescents' interest in trying flavoured e-cigarettes. *Tob Control*. 2016;25(Suppl 2):ii62-ii66. doi:10.1136/tobaccocontrol-2016-053174.

³⁶ Morean ME, Butler ER, Bold KW, Kong G, Camenga DR, Cavallo DA, Simon P, O'Malley SS, Krishnan-Sarin S. Preferring more e-cigarette flavors is associated with e-cigarette use frequency among adolescents but not adults. *PloS one*. 2018 Jan 4;13(1):e0189015

³⁷ Loukas A, Jackson CD, Marti CN, Perry CL. Flavored tobacco product use among youth and young adults: What if flavors didn't exist? *Tob Regul Sci*. 2017;3(2):168-173.

To capitalize on e-cigarette popularity among youth, manufacturers use social media channels to promote their products. Often such social media is driven by adolescents, although nearly 80% of the social media is industry driven in some platforms.³⁸ JUUL's principal advertising themes were closely aligned with Marlboro advertising (pleasure/relaxation, socialization/romance, style/ identity, and satisfaction). JUUL's advertising was widely distributed on social media channels, amplified by hashtag extensions, and catalyzed by compensated influencers. Its social media channels, especially Instagram, have a viral presence although JUUL itself has disbanded use of social media in the United States. JUUL's success has led to the marketing of a number of copy-cat devices.³⁹

Misperceptions. Given the marketing, misleading labelling of e-cigarette packaging, flavors, and other messaging received by youth, it is not surprising that adolescents underestimate the health risks of Juul and other e-cigarettes. Youth don't always recognize that e-cigarettes including Juul contain any tobacco⁴⁰ or nicotine,⁴¹ many youth also believe that e-cigarettes are safer than cigarettes,⁴² and that e-cigarettes just contain water vapor.³¹ Further, adolescents believe that second-hand

³⁸ Clark EM, Jones CA, Williams JR, et al. Vaporous marketing: uncovering pervasive electronic cigarette advertisements on Twitter. *PLoS One*. 2016;11(7):e0157304

³⁹ Jackler RK, Ramamurthi D. Nicotine arms race: JUUL and the high-nicotine product market. *Tob Control*. February 2019:tobaccocontrol-2018-054796. doi:10.1136/tobaccocontrol-2018-054796

⁴⁰ Gorukanti A, Delucchi K, Ling P, Fisher-Travis R, Halpern-Felsher B. Adolescents' attitudes towards e-cigarette ingredients, safety, addictive properties, social norms, and regulation. *Preventive medicine*. 2017;94:65-71

⁴¹ Roditis ML, Halpern-Felsher B. Adolescents' perceptions of risks and benefits of conventional cigarettes, e-cigarettes, and marijuana: a qualitative analysis. *Journal of Adolescent Health*. 2015;57(2):179-185

⁴² Gorukanti A, Delucchi K, Ling P, Fisher-Travis R, Halpern-Felsher B. Adolescents' attitudes towards e-cigarette ingredients, safety, addictive properties, social norms, and regulation. *Preventive medicine*. 2017;94:65-71

smoke from e-cigarettes is not a risk,³² and find it more acceptable to use e-cigarettes indoors and outdoors compared to cigarettes.⁴³

Are e-cigarettes important for adult cigarette cessation?

It is important to emphasize that, while some smokers have successfully quit smoking using e-cigarettes (notably daily users of high nicotine delivery systems), most smokers who use e-cigarettes are *less* not more likely to quit smoking. In fact, the overall effect of e-cigarette use is to depress smoking cessation, and thus flavored e-cigarettes do not increase likelihood of cigarette cessation. Moreover, adults **don't need e-cigarettes to stop smoking** conventional cigarettes. There are numerous studies showing that nicotine replacement therapy, cognitive behavioral or other therapy, and other non-electronic cigarette cessation techniques are effective. If Juul or other e-cigarette companies really wanted a device that would help adults quit smoking, they would have made them only in tobacco flavor, would not have made them small and sleek so youth can hide their use, and would have a step-down nicotine plan whereby people can titrate down the amount of nicotine they use.

Further Evidence of Immediacy of the e-cigarette Problem: Requests for Education, Prevention, and Cessation across the US

I am the Founder and Executive Director of the [Tobacco Prevention Toolkit](#), an online, free set of curriculums and materials for educators and parents to use with middle and high school students to prevent and reduce youth use of all tobacco products. We have an entire section of the Toolkit just on [e-cigarettes](#). The Toolkit was

⁴³ Gorukanti A, Delucchi K, Ling P, Fisher-Travis R, Halpern-Felsher B. Adolescents' attitudes towards e-cigarette ingredients, safety, addictive properties, social norms, and regulation. *Preventive medicine*. 2017;94:65-71

launched in September 2016. We receive **daily** requests for more information about our Toolkit, and in particular our e-cigarette and Juul prevention curriculum. Schools are aware of the e-cigarette and in particular Juul use epidemic in their schools and are frantically trying to find ways to help prevent and reduce such use in their schools and communities.

Schools are spending an enormous amount of time, money, and resources directly related to the e-cigarette epidemic. Schools have served as an effective venue for the delivery of drug education and awareness programming. Drug treatment services, however, are not commonly provided at schools due to legal and/or staffing constraints. Schools and parents need resources, funding, and immediate action. Many schools don't have a nurse or counselor on site to help with students caught vaping or needing help stopping their addiction. Further, many students don't have adequate access to health care or treatment aids including medication, and schools don't have the resources or feel comfortable intervening between parents and their children. Further, we have NO data to inform e-cigarette cessation for youth. Currently there are no nicotine replacement therapies (NRT) or other medicines approved by the FDA for use with anyone under the age of 18. While many healthcare providers are nevertheless prescribing NRTs, clinicians lack guidance on the NRT dosage to provide; this gap is especially salient if you consider the extreme amount of nicotine in a Juul pod or other pod-based e-cigarettes. The need to provide students, schools, and parents with education, prevention, and cessation resources is immediate and critical.

As evidence of the dramatic increase in requests by schools for e-cigarette and in particular Juul-related prevention education, in 2018 we conducted 28 educator

trainings across the US, with 730 educators trained. In just the first 9 months of 2019, we have already conducted 38 trainings across the US, and trained over 1,300 educators. In total, we have reached over **1,133,884 youth**.

Summary, Conclusions, and Policy Needs. In sum, the evidence is clear. Youth are using e-cigarettes, including Juul and other pod-based products, in record numbers. The increase in use of e-cigarettes is undermining and repealing the great progress that has been made by tobacco control efforts over the past two decades. Such increases in e-cigarette use come at a time when youth have negative views of cigarettes, and were unlikely to have initiated nicotine use with cigarettes.⁴⁴ **Immediate efforts are needed to reduce the epidemic of youth e-cigarette use.** Several **actions** should be considered, including raising the purchase age to 21, eliminating access to flavored tobacco products, and raising taxes to ensure that e-cigarette devices and e-liquids have the same price point as other tobacco products. We also need to enact a nicotine standard that applies to e-cigarettes (and all tobacco products). In the US, there is no maximum amount, concentration, or percentage of nicotine that can be in a tobacco product. Allowing a single tobacco product that has the amount of nicotine found in 1.5 to 2 packs of cigarettes is unacceptable, especially when the formula of the nicotine is easier to inhale and absorb. If e-cigarette companies want to propose higher levels of nicotine, they can be then used in prescription form, after the companies apply for and receive FDA authorization to be sold as cessation (drug) products. There is also an urgent need for education, prevention, and cessation programs. We have an

⁴⁴ McKelvey, K. & Halpern-Felsher, BL. Adolescent cigarette-smoking perceptions and behavior: Tobacco control gains and gaps amidst the rapidly expanding tobacco market 2001-2015. *Journal of Adolescent Health*. 2017 Feb;60(2):226-228. PMID: 27939880.

unprecedented number of youth addicted to nicotine through e-cigarette use, with no evidence-based medicine or guidelines for nicotine replacement therapy, behavioral therapies, or other help to provide schools, healthcare providers, educators, or youth. There is a real need for increased tobacco control program funding to fight the youth e-cigarette epidemic generally, but also to provide more education, prevention, and cessation services in schools. It is important to note that such education, prevention, and cessation programs should NOT be conducted by the tobacco/e-cigarette companies. There has been a history of these companies providing ineffective and often inappropriate, misleading, and harmful messages to youth.⁴⁵

Other solutions to the youth e-cigarette epidemic for which the FDA or other governmental agencies have authority include: prohibiting the online marketing and advertisements of e-cigarettes including prohibiting celebrity sponsorships and sponsorships at sporting and music events, where youth attend; prohibiting coupons and other promotional materials;⁴⁶ and regulating the design of e-cigarettes so they are less appealing to youth. It is also important that the FDA not allow any claims made that e-cigarettes are safe or less harmful than cigarettes, and that all e-cigarettes be pulled from the market until they have received pre-marketing authorization from the FDA.

The FDA has the authority to do these actions now.

Thank you.

⁴⁵ Liu, J. & H-F, B. *The Juul Curriculum is Not the Jewel of Tobacco Prevention-Curriculum*. *Journal of Adolescent Health*, 63, 527-528, 2018. PMID 30348276

⁴⁶ Magid, H., Bradshaw, P.T., Ling, P. and **Halpern-Felsher, B.** Ownership of promotional materials predicts initiation of alternative tobacco products used among adolescents and young adults. *JAMA Network Open*. 2019 May 03;2(5):e194006. PMID: 31099874