



JUUL AND OTHER HIGH NICOTINE E-CIGARETTES ARE ADDICTING A NEW GENERATION OF YOUTH

Launched in 2015, JUUL quickly disrupted the e-cigarette marketplace, popularizing e-cigarette devices that are sleek, discreet and have sweet flavors and a powerful nicotine hit. Nicotine is highly addictive, can negatively impact the development of the adolescent brain, and can harm the cardiovascular system.¹ Youth e-cigarette use in the United States has skyrocketed to what the U.S. Surgeon General and the FDA have called “epidemic” levels, with more than 5 million middle and high school students using e-cigarettes.² Former FDA Commissioner Scott Gottlieb has stated, “There’s no question the Juul product drove a lot of the youth use.”³ The Surgeon General has called for “aggressive steps to protect our children from these highly potent products that risk exposing a new generation of young people to nicotine.”⁴

Use of Nicotine Salts Makes it Easier for New Users to Try E-Cigarettes

Just like the tobacco industry has used additives and design changes to make cigarettes more addictive and appealing to new users (particularly youth),⁵ JUUL pioneered a new e-liquid formulation that delivers nicotine more effectively and with less irritation than earlier e-cigarette models. According to the company, the nicotine in JUUL is made from “nicotine salts found in leaf tobacco, rather than free-base nicotine,” in order to “accommodate cigarette-like strength nicotine levels.”⁶ JUUL’s original patent stated that, “certain nicotine salt formulations provide satisfaction in an individual superior to that of free base nicotine, and more comparable to the satisfaction in an individual smoking a traditional cigarette. The satisfaction effect is consistent with an efficient transfer of nicotine to the lungs of an individual and a rapid rise of nicotine absorption in the plasma,” and that, “a user of an e-cigarette comprising the nicotine salt formulation will experience a comparable rate of physical and emotional satisfaction from using a formulation comprising a mixture of nicotine salts prepared with an appropriate acid at least 1.2X to 3X faster than using a formulation comprising a freebase nicotine.”⁷

According to a 2018 Surgeon General advisory on e-cigarette use among youth, nicotine salts allow users to inhale high levels of nicotine more easily and with less irritation than e-cigarettes that use free-base nicotine. As a result, it could be easier for young people to initiate the use of nicotine with these products.⁸ Educating youth about the dangers of JUUL and nicotine use is critical—a study from Truth Initiative found that 63 percent of 15-24 year old JUUL users did not know the product always contains nicotine, even though all pods sold from JUUL do contain nicotine.⁹ On the other hand, many youth are well aware of the powerful nicotine punch that JUUL delivers, seeking out what they call a “head rush.”¹⁰

JUUL’s High Nicotine Content Disrupted the E-Cigarette Marketplace

JUUL Labs claims that the nicotine in a JUULpod is equivalent to that of a pack of 20 cigarettes. Unlike most e-cigarettes, which had previously advertised their nicotine content by volume, JUUL advertised its nicotine content by weight when it entered the market in 2015. The advertised 5% nicotine level by weight would be the equivalent of 5.9% by volume, making JUUL three or more times as powerful as most e-cigarettes on the market prior to 2015, which had a nicotine content of 1-2% by volume.¹¹ One study found that the nicotine emissions from one puff of the JUUL device are equivalent to up to 10 puffs from closed system devices on the market prior to JUUL.¹² The 5% nicotine JUULpods sold in the U.S. exceed nicotine level limits set by many other countries.

JUUL’s competitors, seeking to emulate the company’s success, have since flooded the U.S. market with similar pod-based e-cigarettes, including some that have nicotine levels even higher than 5%, resulting in what some researchers have referred to as a “nicotine arms race.” By September 2018, researchers had identified 14 brands offering “JUUL-compatible” pods and 39 JUUL knock-off devices that offered nicotine levels equal or higher to that of JUUL. Many of these companies offer the devices and pods for cheaper than JUUL and in a wider variety of kid-friendly flavors.¹³ An analysis of e-cigarette sales in Nielsen-

tracked channels¹⁴ found that products with 5% nicotine or higher increased from 0% of dollar sales in 2013 to 31.8% in 2017, and then doubled to 66.4% in 2018. From 2017 to 2018, the market share for fruit-flavored e-liquids nearly doubled, from 14.6% to 27.7% of dollar sales. In 2018, fruit-flavored e-liquids had a higher mean nicotine concentration (4.7%) than any other flavor category.¹⁴



Vuse Alto pods in Mixed Berry flavor (5% nicotine); EonSmoke “JUUL Compatible” pods in Pink Lemonade flavor (6% nicotine); Pods JUUL-Compatible pods in Iced Pineapple flavor (6% nicotine); 4X Pods “JUUL Compatible” Pods in Strawberry Kiwi (6.8% nicotine)

A pending lawsuit against JUUL from the state of North Carolina asserts that JUUL deceived consumers by understating the nicotine levels of its product and its addiction potential.¹⁵ The lawsuit claims that, “JUUL entered the e-cigarette market with among the highest nicotine potency of any product, a nicotine level so high that, in some countries, it is illegal for consumers of any age. JUUL has deceived consumers about that nicotine strength, has misrepresented the nicotine equivalency of its products to traditional cigarettes, and has understated the risks of addiction that occur with such powerful levels of nicotine.”

Kids are Not Just “Experimenting” with E-Cigarettes

Kids are no longer just experimenting with e-cigarettes, but are using them frequently, leading to an addiction that is difficult to break. According to the CDC, among youth who had used e-cigarettes in the past 30 days in 2018, 27.7 percent of high schoolers and 16.2 percent of middle schoolers were frequent users of e-cigarettes, using e-cigarettes on at least 20 of the preceding 30 days. This amounts to more than 900,000 middle and high school students who were frequent users of e-cigarettes.¹⁶

Adolescents are more likely to experience nicotine dependence at lower levels of exposure than adults and can feel dependent after just minimal exposure and within a relatively short period of time.¹⁷ A review of the evidence on the impacts of nicotine on the developing brain, published in the *American Journal of Preventive Medicine*, concluded that, “evidence is currently sufficient to warrant extreme caution regarding exposure of adolescents to exogenous nicotine.”¹⁸ One study estimated that youth could meet the threshold for nicotine addiction by consuming just one quarter of a JUULpod per day.¹⁹ A small study of users of JUUL and other JUUL-like devices (including Bo, Phix and Sourin) ages 13-21 found that their urinary cotinine levels far exceeded that of youth cigarette smokers.²⁰

News reports across the country have documented troubling stories of teens facing unexpected addiction to JUUL and other e-cigarettes:

“The kids who did it for like a month because it was popular got addicted and couldn’t stop.”

* Tracked data includes mass channel and convenience stores; does not include online sales or sales from tobacco and vape shops.

– high school junior, Massachusetts.²¹

“I’ve tried to stop, and over the summer I stopped for a few weeks, but honestly, I’m addicted to nicotine. Like if I don’t have it, I think about it all the time.”

– high school senior, Georgia.²²

Whenever he put the Juul away, he says, the stress and negative feelings would return. **“I felt kind of trapped,”** he recalls. He would go back to it. **“I couldn’t stop,”** he says.

– high school freshman, North Carolina.²³

“I realized that I couldn’t stop...When I started hearing all the facts and everything bad about it, it was already too late. I was already hooked onto it.”

– 8th grader, New York.²⁴

He would come to hate himself for being dependent on the tiny device, which he nicknamed his “11th finger.” Yet any thought of quitting made him crazy-anxious.

– high school student, Massachusetts.²⁵

“It’s impossible to let go once you started using. I’ll tell you — after even an hour and a half or two, I am chomping at the bit to find my Juul.”

– college student who started using as a high school sophomore, Colorado.²⁶

Pediatricians across the country have echoed concerns about nicotine addiction in young patients who are using e-cigarettes:

“Nicotine addiction can take hold in only a few days, especially in the developing adolescent brain that is particularly vulnerable to addiction to nicotine. My teenage patients who use JUUL are not merely engaging in harmless youthful experimentation. Many of them are using JUUL on a daily basis and show significant signs of nicotine addiction.”

-Dr. Jonathan Winickoff, American Academy of Pediatrics²⁷

“With the Juuls, kids are able to get a much higher dose of nicotine — and dose matters. These kids have behaviors that we often see in patients who have opioid or marijuana addiction, but we didn’t typically see with kids who developed addiction to traditional tobacco cigarettes.”

-Dr. Sharon Levy, Director of the Adolescent Substance Use and Addiction Program at Boston Children’s Hospital²⁸

Health Concerns for Youth Exposure to Nicotine

According to the Surgeon General, “E-cigarette use poses a significant – and avoidable – health risk to young people in the United States. Besides increasing the possibility of addiction and long-term harm to brain development and respiratory health, e-cigarette use is associated with the use of other tobacco products that can do even more damage to the body.”²⁹ Nicotine is a highly addictive drug that can have lasting damaging effects on adolescent brain development—the brain keeps developing until about age 25. In particular, nicotine use can harm the parts of the adolescent brain responsible for attention, learning, mood and impulse control.³⁰ The Surgeon General concluded that, “The use of products containing nicotine in any form among youth, including in e-cigarettes, is unsafe.”³¹

In general, nicotine has been found to impact the cardiovascular system.³² A 2018 report by the National Academies of Science, Engineering and Medicine (NASEM) found that the nicotine in e-cigarettes can increase heart rate and diastolic blood pressure in users shortly after use, but the long-term evidence was not available to determine an association between e-cigarette use and other cardiovascular outcomes such as heart disease and stroke. However, the NASEM report acknowledged that the nicotine in e-cigarettes could elevate cardiovascular disease risk in users with pre-existing cardiovascular disease.³³

Delivered in high doses, nicotine can be lethal. The Surgeon General's report and the NASEM report both found that contact with e-liquids can cause adverse health effects and ingesting e-liquids can lead to death.³⁴ Exposure to liquid nicotine found in e-cigarettes has resulted in thousands of calls to poison control centers in recent years according to the American Association of Poison Control Centers (AAPCC).³⁵ Reports of nicotine poisoning from e-cigarettes peaked in 2014 and declined for several years, but as of 2018 are on the rise again. The FDA is currently investigating over 100 cases of reported seizures that may be linked to nicotine poisoning from e-cigarette use.³⁶

There is also concern that use of e-cigarettes may function as a gateway to the use of more dangerous, combustible tobacco products. In 2016, the Surgeon General concluded that e-cigarette use is "strongly associated" with the use of other tobacco products among youth and young adults, including conventional cigarettes.³⁷ The NASEM found a causal link between e-cigarette and cigarette smoking initiation, concluding that, "There is substantial evidence that e-cigarette use increases risk of ever using combustible tobacco cigarettes among youth and young adults."³⁸ An analysis of data from the FDA's nationally representative Population Assessment of Tobacco and Health (PATH) study found that from 2013 to 2016, youth (ages 12-15) e-cigarette use was associated with more than four times the odds of trying cigarettes and nearly three times the odds of current cigarette use. The researchers estimate that this translates to over 43,000 current youth cigarette smokers who might not have become smokers without e-cigarettes.³⁹ In addition, several studies find that the link between e-cigarette use and smoking initiation was stronger for those who had *lower* risk factors for smoking at baseline.⁴⁰

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

2011	269
2012	459
2013	1,540
2014	4,011
2015	3,733
2016	2,899
2017	2,470
2018	3,137
Through July 2019	2,439

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

For more information on JUUL, visit:

<https://www.tobaccofreekids.org/what-we-do/industry-watch/e-cigarettes>

Campaign for Tobacco-Free Kids, September 12, 2019 / Laura Bach

¹ CDC, *About Electronic Cigarettes (E-Cigarettes)*, last reviewed November 15, 2018, https://www.cdc.gov/tobacco/basic_information/e-cigarettes/about-e-cigarettes.html. HHS, *How Tobacco Smoke Causes Disease: The Biology and Behavioral Basis for Smoking-Attributable Disease: A Report of the Surgeon General*, Centers for Disease Control and Prevention, Office on Smoking and Health, 2010 <http://www.ncbi.nlm.nih.gov/books/NBK53017/>.

² Edney, A., et al., "Vaping Furor Intensifies as Trump Vows Tough U.S. Scrutiny", *Bloomberg*, September 11, 2019, <https://www.bloomberg.com/news/articles/2019-09-11/trump-to-hold-meeting-on-vaping-after-reports-of-u-s-illness>.

³ Belluz, J., "Scott Gottlieb's last word as FDA chief: Juul drove a youth addiction crisis," *Vox*, April 5, 2019, <https://www.vox.com/science-and-health/2019/4/5/18287073/vaping-juul-fda-scott-gottlieb>.

⁴ Office of the Surgeon General, "Surgeon General's Advisory on E-Cigarette Use Among Youth," December 18, 2018, <https://e-cigarettes.surgeongeneral.gov/documents/surgeon-generals-advisory-on-e-cigarette-use-among-youth-2018.pdf>.

⁵ Campaign for Tobacco-Free Kids, *Designed for Addiction: How the Tobacco Industry Has Made Cigarettes More Addictive, More Attractive to Kids and Even More Deadly*, June 2014, https://www.tobaccofreekids.org/assets/content/what_we_do/industry_watch/product_manipulation/2014_06_19_DesignedforAddiction_web.pdf.

⁶ Pax Labs, Inc. (former name of JUUL Labs), *Pax Labs, Inc. Granted U.S. Patent for Nicotine Salt E-Cigarette*, December 22, 2015, https://www.juulvapor.com/media/wysiwyg/JUUL/JUUL_USPTO_Patent_Press_Release_15-1216.pdf.

⁷ JUUL patent: Nicotine salt formulations for aerosol devices and methods thereof. 2013 <https://patents.google.com/patent/CA2909967A1/en> (Accessed 16 July 2019).

⁸ Office of the Surgeon General, "Surgeon General's Advisory on E-Cigarette Use Among Youth," December 18, 2018, <https://e-cigarettes.surgeongeneral.gov/documents/surgeon-generals-advisory-on-e-cigarette-use-among-youth-2018.pdf>.

⁹ Willett, J, et al., "Recognition, use and perceptions of JUUL among youth and young adults," *Tobacco Control*, published online April 18, 2018. See also: <https://truthinitiative.org/news/juul-e-cigarettes-gain-popularity-among-youth>.

- 10 Hoffman, J, "The Price of Cool: A Teenager, a Juul and Nicotine Addiction," *New York Times*, November 16, 2018, <https://www.nytimes.com/2018/11/16/health/vaping-juul-teens-addiction-nicotine.html>.
- 11 Jackler, RK, Ramamurthi, D, "Nicotine arms race: JUUL and the high-nicotine product market" *Tobacco Control*, published online February 6, 2019.
- 12 Talih, S, et al., "Characteristics and toxicant emissions of JUUL electronic cigarettes," *Tobacco Control*
- 13 Jackler, RK, Ramamurthi, D, "Nicotine arms race: JUUL and the high-nicotine product market" *Tobacco Control*, published online February 6, 2019.
- 14 Romberg, AR, et al., "Patterns of nicotine concentrations in electronic cigarettes sold in the United States, 2013-2018," *Drug and Alcohol Dependence*, published online August 5, 2018.
- 15 Turner, A, "North Carolina AG sues e-cigarette maker JUUL, says it 'downplayed' dangers of nicotine to children," CNBC, May 15, 2019, <https://www.cnbc.com/2019/05/15/north-carolina-ag-sues-e-cigarette-maker-juul-for-downplaying-dangers.html>.
- 16 CDC, "Use of Electronic Cigarettes and Any Tobacco Product Among Middle and High School Students—United States, 2011-2018," *MMWR*, 67(45): 1276-1277. https://www.cdc.gov/mmwr/volumes/67/wr/mm6745a5.htm?s_cid=mm6745a5_w. Current use defined as any use in the past month.
- 17 HHS, *How Tobacco Smoke Causes Disease: The Biology and Behavioral Basis for Smoking-Attributable Disease: A Report of the Surgeon General*, 2010; HHS, *Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General*, 2012
- 18 England, LJ, et al., "Nicotine and the Developing Human, A Neglected Element in the Electronic Cigarette Debate," *American Journal of Preventive Medicine*. [Epub ahead of print], pii: S0749-3797(15)00035-5. doi: 10.1016/j.amepre.2015.01.015, March 7 2015, at 5
- 19 Jackler, RK, Ramamurthi, D, "Nicotine arms race: JUUL and the high-nicotine product market" *Tobacco Control*, published online February 6, 2019.
- 20 Goniewicz, M, et al., "High exposure to nicotine among adolescents who use Juul and other vape pod systems ('pods')," *Tobacco Control*, published online September 7, 2018.
- 21 Gavin, C. "As teen e-cigarette use climbs in Mass., nicotine addiction worsens," *Boston Globe*, December 12, 2018, <https://www.boston.com/news/health/2019/03/25/teenage-e-cigarette-nicotine-addiction-massachusetts>.
- 22 Morrison, C, "Teens Who Vape: Who Are They?" *Atlanta Jewish Times*, December 12, 2018, <https://atlantajewishtimes.timesofisrael.com/teens-who-vape-who-are-they/>.
- 23 McKay, B, "Teen Vaping Has Created Addicts With Few Treatment Options," *Wall Street Journal*, December 18, 2018, <https://www.wsj.com/articles/surge-in-teen-vaping-gives-rise-to-nicotine-addiction-11545142195>.
- 24 Nedelman, M and Selig, R, "Juul ramped up nicotine levels, and competitors followed, study says," *CNN*, February 7, 2019, <https://www.cnn.com/2019/02/07/health/juul-nicotine-arms-race-study/index.html>.
- 25 Hoffman, J, "The Price of Cool: A Teenager, a Juul and Nicotine Addiction," *New York Times*, November 16, 2018, <https://www.nytimes.com/2018/11/16/health/vaping-juul-teens-addiction-nicotine.html>.
- 26 Daley, J, "He Started Vaping As A Teen And Now Says Habit Is 'Impossible To Let Go,'" *NPR*, June 7, 2018, <https://www.npr.org/sections/health-shots/2018/06/07/615724991/he-started-vaping-as-a-teen-and-now-says-juul-is-impossible-to-let-go>.
- 27 <https://docs.house.gov/meetings/GO/GO05/20190724/109844/HHRG-116-GO05-Wstate-WinickoffJ-20190724.pdf>
- 28 Balngit, M, "In the 'Juul room': E-cigarettes spawn teen addiction that worries doctors, parents and schools," *Washington Post*, July 26, 2019, https://www.washingtonpost.com/local/education/helpless-to-the-draw-of-nicotine-doctors-parents-and-schools-grapple-with-teens-addicted-to-e-cigarettes/2019/07/25/e1e8ac9c-830a-11e9-933d-7501070ee669_story.html?noredirect=on&utm_term=.1e0e412892d6.
- 29 HHS, *Know the Risks: E-Cigarettes & Young People*, accessed March 15, 2018 at <https://e-cigarettes.surgeongeneral.gov/knowtherisks.html>.
- 30 HHS, *The Health Consequences of Smoking: 50 Years of Progress. A Report of the Surgeon General*, CDC, Office of Smoking and Health (OSH), 2014, <http://www.surgeongeneral.gov/library/reports/50-years-of-progress/index.html>. See also: CDC Office on Smoking and Health, "Quick Facts on the Risks of E-cigarettes for Kids, Teens, and Young Adults," March 2019. Accessed August 9, 2019.
- 31 HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2016.
- 32 HHS, *How Tobacco Smoke Causes Disease: The Biology and Behavioral Basis for Smoking-Attributable Disease: A Report of the Surgeon General*, Centers for Disease Control and Prevention, Office on Smoking and Health, 2010 <http://www.ncbi.nlm.nih.gov/books/NBK53017/>.
- 33 National Academies of Sciences, Engineering, and Medicine (NASEM), *Public Health Consequences of E-Cigarettes*, Washington, DC: The National Academies Press, 2018, <http://nationalacademies.org/hmd/Reports/2018/public-health-consequences-of-e-cigarettes.aspx>.
- 34 HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2016. NASEM, *Public Health Consequences of E-Cigarettes*, 2018.
- 35 American Association of Poison Control Centers, "Electronic Cigarette and Liquid Nicotine," <https://aapcc.org/track/ecigarettes-liquid-nicotine>.
- 36 FDA, "FDA In Brief: FDA encourages continued submission of reports related to seizures following e-cigarette use as part of agency's ongoing scientific investigation of potential safety issue," August 7, 2019, https://www.fda.gov/news-events/fda-brief/fda-brief-fda-encourages-continued-submission-reports-related-seizures-following-e-cigarette-use?utm_source=Elouqa&utm_medium=email&utm_term= Stratcomms&utm_content=Inbrief&utm_campaign=CTP%20News%26Connect%26OS%3A%20Seizures%20Update%20-%20208719. See also FDA, "Statement from FDA Commissioner Scott Gottlieb, M.D., and Principal Deputy Commissioner Amy Abernathy, M.D., Ph.D., on FDA's ongoing scientific investigation of potential safety issue related to seizures reported following e-cigarette use, particularly in youth and young adults," April 3, 2019, <https://www.fda.gov/news-events/press-announcements/statement-fda-commissioner-scott-gottlieb-md-and-principal-deputy-commissioner-amy-abernathy-md-phd>.
- 37 HHS, *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on

Smoking and Health, 2016. See also, Leventhal, AM, et al., "Association of Electronic Cigarette Use With Initiation of Combustible Tobacco Product Smoking in Early Adolescence," *Journal of the American Medicine Association*, 314(7): 700-707, 2015. Wills, Thomas A, et al., "Longitudinal study of e-cigarette use and onset of cigarette smoking among high school students in Hawaii," *Tobacco Control*, published online first January 25, 2016. Wills, TA, et al., "E-cigarette use is differentially related to smoking onset among lower risk adolescents," *Tobacco Control*, published online August 19, 2016. Barrington-Trimis, JL, et al., "E-Cigarettes and Future Cigarette Use," *Pediatrics*, 138(1), published online July 2016.

³⁷ Barrington-Trimis, JL, et al., "E-Cigarettes and Future Cigarette Use," *Pediatrics*, 138(1), published online July 2016. Wills, TA, et al., "E-cigarette use is differentially related to smoking onset among lower risk adolescents," *Tobacco Control*, published online August 19, 2016.

³⁸ NASEM, *Public Health Consequences of E-Cigarettes*, 2018.

³⁹ Berry, KM, et al., "Association of Electronic Cigarette Use with Subsequent Initiation of Tobacco Cigarettes in US Youths," *JAMA Network Open*, 2(2), published online February 1, 2019.

⁴⁰ Barrington-Trimis, JL, et al., "E-Cigarettes and Future Cigarette Use," *Pediatrics*, 138(1), published online July 2016. Wills, TA, et al., "E-cigarette use is differentially related to smoking onset among lower risk adolescents," *Tobacco Control*, published online August 19, 2016. Berry, KM, et al., "Association of Electronic Cigarette Use with Subsequent Initiation of Tobacco Cigarettes in US Youths," *JAMA Network Open*, 2(2), published online February 1, 2019.