



HEALTH ADVISORY – January 28, 2015

Electronic Cigarettes: A Summary of the Public Health Risks and Recommendations for Health Care Professionals

This health advisory seeks to inform health care professionals of the public health risks posed by the marketing, sale and use of electronic cigarettes (e-cigarettes) especially to children and young people. Electronic cigarettes (e-cigarettes) are battery-operated devices, often designed to resemble a cigarette, that deliver and emit a nicotine-containing aerosol. E-cigarettes are considered electronic nicotine delivery devices (ENDS) and have many names. They are frequently referred to as e-cigs, e-hookahs, hookah pens, vapes, vape pens, vape pipes, or mods. There are disposable and rechargeable e-cigarettes as well as refillable “tank systems” that hold a larger volume of the e-cigarette liquid (e-liquid) and that heat the e-liquid to higher temperatures.¹

Toxicity of E-cigarettes and Exposure to Emissions

The heated e-liquid forms an aerosol that contains high concentrations of ultrafine particles that are inhaled and become trapped in the lungs.² Chemicals in the aerosol are absorbed through the blood stream and delivered directly to the brain and all body organs. Analyses of e-liquids by the Food and Drug Administration (FDA) and other laboratories found variability in the content of e-liquids and inaccurate product labeling related to nicotine content and chemicals.³

Typically, e-liquids contain nicotine, flavoring agents, propylene glycol and toxic chemicals known to cause cancer, birth defects and other reproductive harm.^{1, 4-7} While several studies found lower levels of carcinogens in the e-cigarette aerosol compared to smoke emitted by traditional cigarettes, both the mainstream and secondhand e-cigarette aerosol have been found to contain at least ten chemicals that are on California’s Proposition 65 list of chemicals known to cause cancer, birth defects or other reproductive harm, including acetaldehyde, benzene, cadmium, formaldehyde, isoprene, lead, nickel, nicotine, n-nitrosornicotine, and toluene.^{1, 5-7}

E-cigarette emissions are also a health concern for those exposed to the secondhand aerosol. Although not as dangerous as secondhand smoke from combustible tobacco products, people exposed to e-cigarette aerosol absorb nicotine at levels comparable to people exposed to secondhand smoke.⁸ E-cigarette emissions also contain volatile organic compounds (VOCs) and fine/ultrafine particles.⁶ These ultrafine particles can travel deep into the lungs where they get trapped and may lead to tissue inflammation.⁹

Health Effects of Nicotine

Nicotine, the primary psychoactive ingredient in e-liquid, stimulates pleasure/reward pathways in the brain. It is a highly addictive neurotoxin that is as addictive as heroin and cocaine.^{10, 11} It affects the cardiovascular and central nervous systems, causing blood vessels to constrict, raising the pulse and blood pressure.¹² Nicotine adversely affects maternal and fetal health during pregnancy, contributing to low birth weight, preterm delivery and stillbirth.¹³ Nicotine is also known to cross the placenta and is detectable in the breast milk of smoking mothers as well as mothers exposed to secondhand smoke.^{14, 15} Preliminary studies show that using a nicotine-containing e-cigarette for just five minutes causes similar lung irritation, inflammation and effect on blood vessels as smoking a traditional cigarette, which may increase the risk of a heart attack.^{1, 9}

Exposure to and use of nicotine products by adolescents is of particular concern because adolescence is a critical period for brain growth and development. As a consequence, adolescents are especially vulnerable to the toxic effects of nicotine. Exposure to nicotine during adolescence may harm brain development and predispose future tobacco use.^{13, 16, 17} Even a brief period of continuous or intermittent nicotine exposure in adolescence elicits lasting neurobehavioral damage.¹⁸

Nicotine Poisonings

E-liquids are available in flavors such as bubble gum, cherry and chocolate, which makes them appealing to children and youth. E-cigarette cartridges and e-liquid bottles are not equipped with child resistant caps and often leak, creating a potential source of poisoning through ingestion and skin or eye contact. Even a small amount of e-liquid ingested by a small child can be lethal.¹⁹

There has been a significant rise in the number of calls to poison control centers for both adults and children who were accidentally exposed to e-liquids.²⁰ Nationally, the number of calls rose from one per month in September 2010 to 215 per month in February 2014.²¹ Figure 1 depicts e-cigarette-related calls to the California Poison Control Center over a five year period. In California, from 2012 to 2014, the number of calls to the poison control center

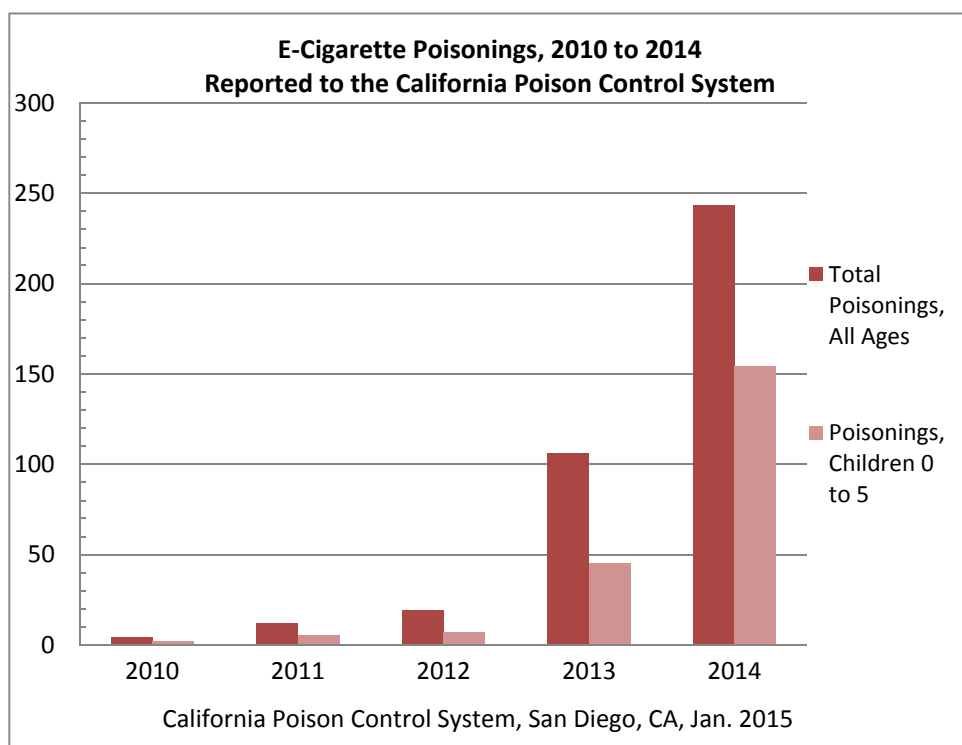


Figure 1: E-cigarette-related calls to the California Poison Control System.

involving e-cigarette exposures in children five and under increased sharply from 7 to 154. By the end of 2014, e-cigarette poisonings to young children tripled in one year, making up more than 60% of all e-cigarette poisoning calls. Adults have also mistakenly used e-liquid in harmful ways, such as eye drops, and have been harmed by exploding cartridges.

E-cigarette Use and Youth

Recent national and preliminary California data show that youth are experimenting with e-cigarettes at an alarming rate. In 2014, the Monitoring the Future survey, which tracks substance abuse trends among over 40,000 youth nationally, found that the use of e-cigarettes among teens surpassed the use of traditional cigarettes. More than twice as many 8th and 10th graders reported using e-cigarettes than traditional cigarettes in the survey, and among 12th graders, 17 percent reported currently using e-cigarettes vs. 14 percent using traditional cigarettes.²² Another survey, the National Youth Tobacco Survey, found that in 2013, that e-cigarette use among high school students tripled between 2011 and 2013, increasing from 1.5 percent to 4.5 percent.²³ Over a quarter million students who reported using e-cigarettes had never used traditional cigarettes.²⁴ Overall, studies suggest that youth who may have otherwise never smoked cigarettes are now getting hooked on nicotine due to e-cigarettes, and that adolescents who use e-cigarettes are more likely to progress from experimenting with cigarettes to becoming established smokers.^{25, 26}

E-cigarette devices may also be used to inhale illegal substances, such as marijuana and hash oil.¹⁹ Because many of these devices are similar in appearance to a ball point pen, school and law enforcement personnel are unaware that inappropriate use of nicotine and illegal substances is occurring.

E-cigarette Use and Adults

Among California adults, use of e-cigarettes in the past 30 days doubled from 1.8 percent in 2012 to 3.5 percent in 2013. For younger adults (18 to 29 year old), e-cigarette use tripled in one year from 2.3 percent to 7.6 percent. Young adults are three times more likely to use e-cigarettes than those 30 and older. Nearly 20 percent of young adult e-cigarettes users have never smoked traditional cigarettes.²⁷

E-cigarette Availability

E-cigarettes are readily accessible throughout California, and the number of stores selling e-cigarettes quadrupled between 2011 and 2013, increasing from 12 percent to 46 percent.^{28, 29} Figure 2 depicts the percent of tobacco stores selling e-cigarettes in California counties.

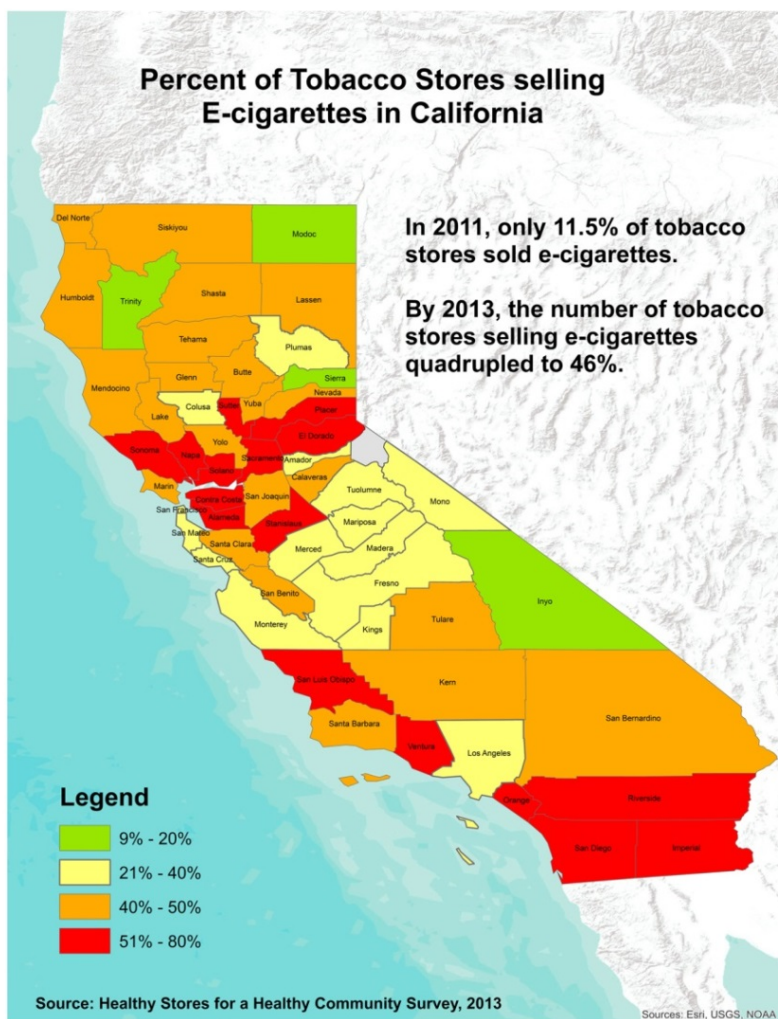


Figure 2: Percent of tobacco stores selling e-cigarettes in CA.

E-cigarette Marketing

Over the past 40 years, great strides have been made to protect youth from tobacco marketing. Numerous state and federal laws and litigation regulate the sale, marketing and distribution of traditional tobacco products and tobacco-related paraphernalia. These restrictions include: prohibiting tobacco advertising on television, radio and billboards; prohibiting youth-oriented tobacco products marketing, including a ban on the sale of flavored cigarettes and the use of cartoon characters; prohibiting free sampling of cigarettes and restrictions on sampling of other tobacco products; restrictions on brand name sponsorship of sporting, music, and cultural events; restrictions on giving away branded promotional items such as t-shirts.³⁰ Presently in California, these restrictions are not interpreted to apply to e-cigarettes. As a result, the e-cigarette industry is legally allowed to use marketing strategies and tactics that are no longer permissible for traditional tobacco products.

Many television networks (e.g., ABC Family, USA, Bravo, E!, MTV, VH1 and Comedy Central) with a substantial proportion of youth viewers, are airing e-cigarette advertising. There is also e-cigarette advertising on radio, internet, billboards, in magazine and print publications, and in stores.³¹ E-liquid containing nicotine is frequently marketed as “e-juice” and is sold in fruit and candy flavors. Promoting and labeling nicotine containing products as “juice” may mislead consumers to believe that e-liquid is safe to ingest and that e-cigarettes pose no health risk.



The use of cartoon characters in advertising and promoting of e-cigarettes as fashion accessories are other ways these products appeal to youth with the implication that these products are harmless (see Figure 3). E-cigarette manufacturers report sponsoring concerts, sporting events, and parties that include the distribution of free samples; many of these events occurred in California.³² Another tactic to create a perception that e-cigarettes are family friendly is through the association of these products with family oriented attractions.



Figure 3: E-cigarette products and accessories.

Cessation Claims

There is no scientific evidence that e-cigarettes help smokers to successfully quit traditional cigarettes or that they reduce consumption of traditional cigarettes.^{25, 33} A number of recent studies show that e-cigarette users are no more likely to quit than regular smokers. One study found that 89 percent of e-cigarette users are still using them one year later and another study found that e-cigarette users are a third less likely to quit cigarettes.^{34, 35} These studies suggest that e-cigarettes are effectively inhibiting people from successfully kicking their nicotine addiction. In addition, dual use of cigarettes and e-cigarettes is continuing to rise, which may diminish any potential benefits of cutting back on traditional cigarettes.³⁶ Continuing to smoke traditional cigarettes, while also using e-cigarettes, does not reduce the cardiovascular health risks.^{1, 37, 38}

California health care providers are recommended to:

Educate, Advise and Protect Unborn Children, Young Children and Adolescents.

- Educate parents, adolescents, and the public, as well as health care personnel, school personnel, child care providers, and community leaders, about these products:
 - Nicotine is contained and is highly addictive and toxic
 - Increases in e-cigarette related poisonings, especially to children.
- Advise that these products are especially harmful to adolescents and pregnant women.
- Advise and warn e-cigarette users about toxicity of these products to themselves and those subjected to secondhand emissions.

Educate About Clean Indoor Air.

- Educate parents and the public to take steps to protect children and themselves from exposure to e-cigarette emissions.

Encourage Cessation.

- Current smokers and e-cigarette users should be advised to quit and offered support.
- Refer users to cessation resources offered by their health insurance plan including access to FDA approved cessation medications.
- The California Smokers' Helpline at 1-800-NO BUTTS is another cessation resource.

Protect Children from Nicotine Poisoning.

- Inform parents and e-cigarette users that e-cigarette cartridges and e-liquid bottles are a potential source of poisoning through ingestion, skin or eye contact. Store these materials out of the reach of children, away from medications, and call the California Poison Control Center at 1-800-222-1221 for expert help in case of accidental exposure.

Promote Health Literacy: Educate about Misleading Marketing.

- Educate parents and e-cigarette users about misleading advertising and labeling.
- Educate adolescents, parents and others about unknown ingredients and rights as consumers to have ingredient disclosure readily accessible.

References

1. Grana, R., N. Benowitz, and S. Glantz, *Background Paper on E-cigarettes*. Center for Tobacco Control Research and Education, University of California, San Francisco and WHO Collaborating Center on Tobacco Control, 2013.
2. Fuoco, F.C., et al., *Influential parameters on particle concentration and size distribution in the mainstream of e-cigarettes*. *Environ Pollut*, 2014. **184**: p. 523-9.
3. Food and Drug Administration, *FDA and public health experts warn about electronic cigarettes*. 2009.
4. California Office of Environmental Health Hazard Assessment, *Safe Drinking Water and Toxic Enforcement Act of 1986*. Current Proposition 65 List [Online].
5. Goniewicz, M.L., et al., *Levels of selected carcinogens and toxicants in vapour from electronic cigarettes*. *Tob Control*, 2014. **23**(2): p. 133-9.
6. Schripp, T., et al., *Does e-cigarette consumption cause passive vaping?* *Indoor Air*, 2012. **23**(1): p. 25-31.
7. Williams, M., et al., *Metal and silicate particles including nanoparticles are present in electronic cigarette cartomizer fluid and aerosol*. *PLoS One*, 2013. **8**(3): p. e57987.
8. Flouris, A.D., et al., *Acute impact of active and passive electronic cigarette smoking on serum cotinine and lung function*. *Inhal Toxicol*, 2013. **25**(2): p. 91-101.
9. Schober, W., et al., *Use of electronic cigarettes (e-cigarettes) impairs indoor air quality and increases FeNO levels of e-cigarette consumers*. *Int J Hyg Environ Health*, 2013.
10. C Everett Koop, M., *Health Consequences of Smoking: Nicotine Addiction a Report of the Surgeon General 1988*. 1988: DIANE Publishing.
11. *Diagnosis Dictionary - Nicotine*. Available online at <http://www.psychologytoday.com/conditions/nicotine>. Psychology Today.
12. US Department of Health Human Services, *How tobacco smoke causes disease: the biology and behavioral basis for smoking-attributable disease: a report of the Surgeon General*. Atlanta, GA: US 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, 2010. **2**.
13. US Department of Health Human Services, *The health consequences of smoking—50 years of progress: A report of the Surgeon General*, in Atlanta, GA: US 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. 2014.
14. Koren, G., *Fetal toxicology of environmental tobacco smoke*. *Curr Opin Pediatr*, 1995. **7**(2): p. 128-31.
15. Luck, W. and H. Nau, *Nicotine and cotinine concentrations in serum and milk of nursing smokers*. *Br J Clin Pharmacol*, 1984. **18**(1): p. 9-15.
16. Centers for Disease Control and Prevention, *Incidence of initiation of cigarette smoking--United States, 1965-1996*. *MMWR. Morbidity and mortality weekly report*, 1998. **47**(39): p. 837.
17. US Department of Health Human Services, *Preventing tobacco use among youth and young adults: A report of the Surgeon General*. Atlanta, GA: US 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, 2012. **3**.
18. Abreu-Villaca Y., S.J., Tate C.A., Slotkin T.A., *Nicotine is a neurotoxin in the adolescent brain: critical periods, patterns of exposure, regional selectivity, and dose thresholds from macromolecular alterations*. *Brain Research*, 2003. **979**: p. 114-128.
19. Cobb, N.K. and D.B. Abrams, *E-cigarette or drug-delivery device? Regulating novel nicotine products*. *N Engl J Med*, 2011. **365**(3): p. 193-5.
20. Cantrell, F.L., *Adverse Effects of e-Cigarette Exposures*. *J Community Health*, 2014. **39**(3): p. 614-6.
21. Chatham-Stephens, K., et al., *Notes from the field: calls to poison centers for exposures to electronic cigarettes - United States, september 2010-february 2014*. *MMWR Morbidity and mortality weekly report*, 2014. **63**(13): p. 292-3.
22. Miech, R.A., Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E., *E-cigarettes surpass tobacco cigarettes among teens.*, in *National press release*. 2014, University of Michigan News Service: Ann Arbor.
23. Centers for Disease Control and Prevention, *Tobacco Use Among Middle and High School Students — United States, 2013*. *MMWR. Morbidity and mortality weekly report*, 2014. **63**(45): p. 1021-1026.
24. Bunnell, R.E., et al., *Intentions to smoke cigarettes among never-smoking U.S. middle and high school electronic cigarette users, National Youth Tobacco Survey, 2011-2013*. *Nicotine & Tobacco Research*, 2014.
25. Dutra, L.M. and S.A. Glantz, *Electronic Cigarettes and Conventional Cigarette Use Among US Adolescents: A Cross-sectional Study*. *JAMA Pediatr*, 2014.
26. Lee, S., R.A. Grana, and S.A. Glantz, *Electronic Cigarette Use Among Korean Adolescents: A Cross-Sectional Study of Market Penetration, Dual Use, and Relationship to Quit Attempts and Former Smoking*. *J Adolesc Health*, 2013.
27. California Tobacco Control Program. California Department of Public Health, *Behavioral Risk Factor Surveillance System (BRFSS) 2012-2013*. 2014.
28. California Tobacco Control Program. California Department of Public Health, *Final report for the California Tobacco Advertising Survey (2011)*. 2013.
29. California Tobacco Control Program. California Department of Public Health. *Health Stores for a Health Community*. 2013; Available from: <http://www.healthystoreshealthycommunity.com/>.
30. ChangeLab Solutions, *Tobacco Laws Affecting California*. 2014.
31. Legacy, *Vaporized: E-cigarettes, Advertising, and Youth*. 2014.
32. A report written by the staff of Senator Richard J. Durbin (D-IL), Representative Henry Waxman (D-CA), Senators Tom Harkin (D-IA), John D. Rockefeller IV (D-WV), Richard Blumenthal (D-CT), Edward J. Markey (D-MA), Sherrod Brown (D-OH), Jack Reed (D-RI), Barbara Boxer (D-CA), Jeff Merkley (D-OR), and Representative Frank Pallone (D-NJ), *Gateway to Addiction?: A Survey of Popular Electronic Cigarette Manufacturers and Targeted Marketing to Youth*. 2014.
33. World Health Organization, *Marketers of Electronic Cigarettes Should Halt Unproven Therapy Claims*. September 19, 2008.
34. Etter, J.F. and C. Bullen, *A longitudinal study of electronic cigarette users*. *Addict Behav*, 2014. **39**(2): p. 491-4.
35. Vickerman, K.A., et al., *Use of electronic cigarettes among state tobacco cessation quitline callers*. *Nicotine Tob Res*, 2013. **15**(10): p. 1787-91.
36. Adkison, S.E., et al., *Electronic nicotine delivery systems: international tobacco control four-country survey*. *Am J Prev Med*, 2013. **44**(3): p. 207-15.
37. Barnoya, J. and S.A. Glantz, *Cardiovascular effects of secondhand smoke: nearly as large as smoking*. *Circulation*, 2005. **111**(20): p. 2684-98.
38. Pope, C.A., 3rd, et al., *Cardiovascular mortality and exposure to airborne fine particulate matter and cigarette smoke: shape of the exposure-response relationship*. *Circulation*, 2009. **120**(11): p. 941-8.