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E-Cigarettes and Oral Health

Over the past several years, electronic cigarettes (also known as e-cigarettes, vapes and vape pens) have become popular devices among both youth and adults, offering a way to deliver nicotine without burning tobacco. On one hand, these devices have been touted as potential tobacco cessation products and on the other hand, chastised for addicting a new generation of young people to nicotine.

A 2018 National Academies of Sciences, Engineering, and Medicine (NASEM) report found that in the short-term, e-cigarettes are less harmful than cigarettes, though not risk-free, and raised many questions about the long-term effects of these products—both on the individual and population levels.[1]

What are E-Cigarettes?

E-cigarettes "produce an aerosol by heating a liquid that usually contains nicotine—the addictive drug in regular cigarettes, cigars, and other tobacco products—flavorings, and other chemicals that help to make the aerosol. Users inhale this aerosol into their lungs."[2] This liquid solution usually contains nicotine, propylene glycol, glycerin, flavorings and other chemicals, and the aerosol often contains flavoring chemicals, such as diacetyl—the chemical used to give microwave popcorn its buttery flavor—and metals (like lead).[3] These devices come in multiple shapes and sizes, with some resembling cigars or pipes and others resembling everyday items, such as USB sticks.

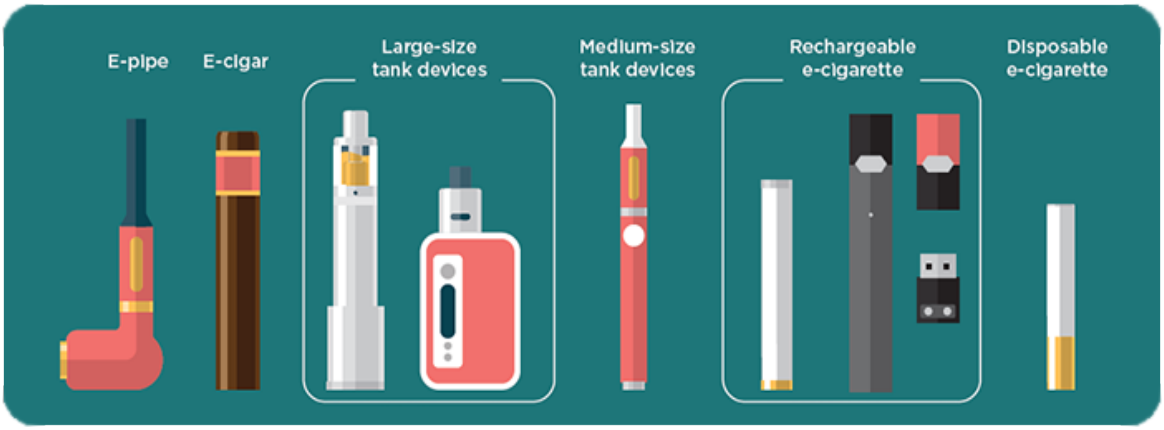

Image credit: "What We Know About Electronic Cigarettes," smokefree.gov

E-Cigarettes and Oral Health

Compared with combustible cigarettes, e-cigarettes have been on the market only a short time, and therefore, the research on e-cigarettes' effects on individual and population health is still in its early phases. Most of what is currently known about e-cigarettes relates to the dangers of nicotine, which include brain and behavior risks and addiction.[4] There is much to learn about how vaping and e-cigarette aerosols may affect one's health, including oral health. Early studies in this space have touched upon the following oral health issues:

Tooth Decay

In a study funded by the American Dental Association Foundation, researchers evaluated the effect of e-cigarette aerosols on tooth surfaces. They found that e-cigarette aerosols have similar properties as high-sucrose, gelatin-based candies like gummy bears and acidic drinks. Specifically, their study showed that four out of five e-liquid flavors tested increased biofilm formation (dental plaque is a biofilm found on natural teeth) and that e-cigarette aerosols occupy pits and fissures of human teeth, which can promote bacterial attachment and lead to tooth decay. [5]

Oral Cancer Potential

A group of National Institute of Dental and Craniofacial Research funded researchers demonstrated that e-cigarette users have significant deregulation of cancer-related genes and associated molecular pathways in the oral epithelium, which is the outermost layer of cells in the mouth, e.g., cheek cells, and is frequently where smoking-associated oral cancer is found.[6] The finding is significant because over 90 percent of all human cancers are of epithelial origin, and the oral epithelium is the first site of exposure to carcinogens present in both e-cigarette vapor and cigarette smoke.

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Gum Disease

The National Heart, Lung, and Blood Institute funded a review into the effects of e-cigarette aerosols on gum and lung health. Researchers found that e-cigarettes, along with various flavoring chemicals, may play a role in the development of gum and lung diseases, such as through lung inflammation, and may affect their ability to heal wounds. These devices and their aerosols—along with their chemical interactions with nicotine—may also produce harmful effects on the cellular and structural elements of the oral cavity, which may result in gum disease and tooth loss.[7]

Dry Mouth

E-cigarette additives, such as propylene glycol (PG), produce mouth irritation and dry cough. Glycol mist may dry out mucous membranes and eyes, though current data into the repeated and potentially long-term inhalation of glycerol vapor associated with e-cigarette use are not sufficient to determine long-term safety.[8]

Research Gaps

When it comes to the body of evidence surrounding e-cigarettes and their effect on long-term health, there are more unknowns than knowns. The 2018 NASEM study identified a number of research gaps, which include the following[1]:

Potential of e-cigarettes to promote smoking cessation and/or harm reduction. While e-cigarettes have been promoted as potential cessation products, research is needed to compare e-cigarettes against other evidence-based cessation treatments, assess adverse events of these devices and determine potential harm to bystanders exposed to e-cigarette emissions.

Association between e-cigarettes and oral health. The NASEM report noted that there is no or limited evidence on a range of oral health-related issues. There are currently no epidemiological studies (studies on the causes of health outcomes and disease) on the association between e-cigarette use and the rate or progression of gum disease; limited evidence that switching to e-cigarettes will improve gum disease in smokers; and limited evidence that e-cigarette aerosols (both with and without nicotine) can negatively affect cell health and cause oral tissue cell damage in non-smokers.

Procedures to quickly evaluate changes to products on the U.S. market. Given the rapidly changing nature of e-cigarettes and their limited time on the market, it has been difficult to make comparisons between devices. The NASEM report identified the need for a way to quickly evaluate changes to products introduced to the market, including their design evolution and the resultant change of chemical substance release patterns.

Resources

There are multiple resources available on the health effects and prevalence of e-cigarettes. They include the following:

- Centers for Disease Control and Prevention (CDC), Smoking & Tobacco Use Website
- Know the Risks: E-Cigarettes & Young People, U.S. Department of Health and Human Services Website
- Public Health Consequences of E-Cigarettes Report, NASEM
- Smokefree.gov Website
- National Institutes of Health (NIH) Research Studies

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[1] National Academies of Sciences, Engineering, and Medicine. 2018. Public health consequences of e-cigarettes. Washington, DC: The National Academies Press. http:/nationalacademies.org/hmd/Reports/2018/public-health-consequences-of-e-cigarettes.aspx

[2] Centers for Disease Control and Prevention. About Electronic Cigarettes (E-Cigarettes). https://www.cdc.gov/tobacco/basic_information/e-cigarettes/about-e-cigarettes.html

[3] National Cancer Institute. What We Know About Electronic Cigarettes. https://smokefree.gov/quit-smoking/ecigs-menthol-dip/ecigs

[4] U.S. Department of Health and Human Services. 2019. Know the Risks: E-Cigarettes & Young People. https://e-cigarettes.surgeongeneral.gov/knowtherisks.html

[5] Kim SA, Smith S, Beauchamp C, Song Y, Chiang M, et al. 2018. Cariogenic Potential of Sweet Flavors in Electronic-Cigarette Liquids. PLOS ONE. 13(9).

[6] Tommasi S, Caliri AW, Caceres A, Moreno DE, Li M, et al. 2019. Deregulation of Biologically Significant Genes and Associated Molecular Pathways in the Oral Epithelium of Electronic Cigarette Users. Int. J. Mol. Sci. 20(3): 738.

[7] Javed F, Kellesarian SV, Sundar IK, Romanos GE, Rahman I. 2017. Recent Updates on Electronic Cigarette Aerosol and Inhaled Nicotine Effects on Periodontal and Pulmonary Tissues. Oral Diseases. 23(8): 1052.

[8] Callahan-Lyon P. Electronic Cigarettes: Human Health Effects. 2014. Tobacco Control. 23: ii36.