UNDERSTANDING THE HEALTH RISKS OF E-CIGARETTES

We have much more to learn about e-cigarettes. According to the Surgeon General, the CDC, and the National Academies of Science, Engineering and Medicine (NASEM), e-cigarettes deliver fewer toxins than combustible cigarettes, but that doesn't mean that they are safe or without risk.[1] In a 2020 report, the Surgeon General found that "the long-term health effects of using these products remain unknown, and short-term risks are only slowly coming into focus."[2]

E-Cigarettes are Not Harmless Water Vapor: E-cigarette aerosol contains nicotine, cancer-causing chemicals and other toxins

- While e-cigarette aerosol contains fewer of most of the chemicals and toxins compared to cigarette smoke, it can still contain harmful and potentially harmful chemicals, including formaldehyde, acrolein, volatile organic compounds like toluene, tobacco-specific nitrosamines, and metals like nickel and lead.[3] Researchers at Johns Hopkins University identified a complex mixture of approximately 2,000 chemicals in four e-cigarette brands. The vast majority of these chemicals were unidentified.[4] More research is needed about the chemicals found in e-cigarettes and the impact of inhaling these chemicals deeply into the lungs.[5]

- Flavored e-cigarettes may pose unique harms. According to the Surgeon General, "while some of the flavorings used in e-cigarettes are generally recognized as safe for ingestion as food, the health effects of their inhalation are generally unknown and noted that some of the flavorings found in e-cigarettes have been shown to cause serious lung disease when inhaled.[6] According to the FDA, "Flavorings that are safe for use in food may become toxic when these chemicals are heated and inhaled. Some have been shown to be harmful to the lungs."[7]

Emerging Evidence of the Harmful Effects of E-cigarettes

- Little is known about the long-term effects of e-cigarette use. Because the popularity of these products is relatively new and users have not had sufficient time to develop symptoms, there is not enough information to assess the long-term impact on cancer, respiratory disease, and heart disease risk.[8]

- In 2021, the WHO Global Tobacco Control Report detailed the emerging evidence of the harmful effects of e-cigarettes, including studies suggesting that e-cigarettes have negative effects on aspects of cardiovascular and respiratory health.[9]

- A 2020 Surgeon General's report also noted that, "Several studies demonstrate e-cigarette aerosol contains fine and ultrafine particles, such that use of the products could potentially increase cardiovascular and respiratory risks."[10]

- E-cigarettes have been found to increase heart rate and blood pressure.[11] A 2021 report of the World Heart Federation identified other concerning changes related to e-cigarette use. The report concluded that more research on the long term effects of e-cigarettes is needed, but the "effects on the cardiovascular system could be substantial."[12] A more recent scientific statement from the American Heart Association (AHA) on the cardiopulmonary impact of electronic cigarettes and vaping products concluded that "The presence of any acute cardiovascular effects of [e-cigarettes] suggests that [e-cigarette] use is not benign and raises the possibility that adverse impact could accumulate over time."[13]

- There is growing evidence that vaping can harm lung health. E-cigarette aerosol inhibits several kinds of immune cells in the lungs, compromising the ability to fight infection.[14] Initial evidence also indicates that e-cigarette aerosols promote inflammation in the respiratory system.[15] Additionally, nicotine, a prominent component of e-cigarette aerosol, is known to suppress immune function throughout the body.[16]

- An extensive review of the evidence on the effects of e-cigarettes on respiratory health noted that the development of serious lung disease usually follows decades of chronic smoking, "so the population effects of e-cigarette use may not be apparent until the middle of this century." The researchers conclude that "current knowledge of these effects is insufficient to determine whether the respiratory health effects of e-cigarette are less than those of combustible tobacco products." Based on the emerging evidence, they found that "e-cigarettes will likely prove to have at least some pulmonary toxicity with chronic and possibly even short term use." [17]

- Initial research indicates that e-cigarette aerosol can damage DNA.[18] Recently, one study found similarly increased levels of DNA damage among exclusive e-cigarette users and exclusive cigarette smokers, compared to nonusers.[19] As noted by the Surgeon General's Report and a recent policy statement from the American Association for Cancer Research (AACR) and the American Society of Clinical Oncology (ASCO), it is biologically plausible that over time the DNA damage from long-term exposure to e-cigarette aerosols could increase risk of cancer. However, the Surgeon General, AACR, and ASCO also agree that the evidence remains uncertain whether the level of exposure is high enough to contribute to the formation of cancer in humans.[20]

- CDC warns that e-cigarettes and other products containing nicotine are not safe to use during pregnancy, noting that nicotine is "a health danger for pregnant women and developing babies and can damage a developing baby's brain and lungs."[21]

- Emerging research suggests that e-cigarette use has a negative effect on oral health.[22] Nicotine impacts blood flow to the gums and could lead to inflammation of the gums and gum disease after continued use.[23] The chemicals in e-cigarettes also stay in the mouth, and can soften tooth enamel and contribute to tooth decay.[24] Vaping also changes the balance of bacteria in the mouth in ways that put users at higher risk of oral infections.[25]

- The variation in e-cigarettes now on the market can also impact their potential health impacts. Devices can have powerful batteries that create more aerosol and expose users to more toxicants. The proliferation of e-liquids with nicotine salts allow users to inhale significantly higher levels of nicotine.[26]

Any Potential Benefit To Smokers Comes From Complete Switching, Yet Many E-Cigarette Users Continue To Smoke

- "Lower risk" or "less harmful" is only relevant when you are talking about an adult cigarette smoker switching completely to an e-cigarette. According to the 2021 NHIS, the majority of adults using e-cigarettes either still smoke (dual use 29%) or have *never* been smokers (30%).[27]

- While noting that the evidence is insufficient to recommend e-cigarettes for smoking cessation, CDC states that, "e-cigarettes may help non-pregnant adults who smoke if used as a complete substitute for all cigarettes and other smoked tobacco products."[28] Otherwise, dual use, even with cutting back the number of cigarettes smoked, still elevates smokers' health risks for things like cardiovascular disease.[29] According to the NASEM report, "there is no available evidence whether or not long-term e-cigarette use among smokers (dual use) changes morbidity or mortality compared with those who only smoke combustible tobacco cigarettes."[30]

E-Cigarettes Pose Significant Risks to Kids' Health

- 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."[31]

- The Surgeon General concluded that, "The use of products containing nicotine in any form among youth, including in e-cigarettes, is unsafe."[32]

- Similarly, the FDA warns that "Vaping is not harmless. … Teens who vape may experience coughing, wheezing, nausea, vomiting, headaches, and dizziness."[33]

- While it's too early to confirm long-term health outcomes – "it took ~50 years before the connection between tobacco smoking and the multitude of smoking-related diseases became clear" - AHA's

2022 scientific statement, focused on the cardiopulmonary consequences of vaping in adolescents, found that:[34]

  - Available studies on short-term effects, such as changes in vascular stiffness, blood pressure, and heart rate, suggest that vaping during adolescence may lead to increased likelihood of cardiovascular disease later in life.
  - Further, "[l]ung development continues into the early 20s, and adolescents who vape are at risk for stunting or altering their lung development such that they never reach their full lung function potential, … humans who vape during their adolescent years will likely have lower lung function and thus will become symptomatic at a lower threshold with any additional insult such as asthma, chronic obstructive pulmonary disease, pneumonia, or interstitial lung disease."

- In 2021, feelings of anxiety, stress, and depression was reported as the most common reason for continuing to use e-cigarettes among current youth e-cigarette users.[35] Early research has found that youth e-cigarette use is associated with mental health symptoms, such as depression.[36] When youth depend on nicotine, the addiction can lead to a cycle of temporary symptoms of nicotine withdrawal, such as irritability, restlessness, and feelings of anxiety and depression.[37] This cycle can be yet another source of stress.

- Nicotine is a highly addictive drug that can have lasting damaging effects on adolescent brain development and impacts attention, memory and learning.[38] According to the Surgeon General, nicotine can also prime the brain for addiction to other drugs.[39]

- Some of the pod systems and disposable products deliver massive doses of nicotine, putting youth users at greater risk of addiction. Juul has stated that each Juul "pod" (cartridge of nicotine) delivers as much nicotine as a pack of 20 cigarettes. Many e-cigarette products use nicotine salts, which allow users to inhale high levels of nicotine more easily and with less irritation. As a result, it could be easier for young people to initiate the use of and quickly become addicted to nicotine with these products.[40]

- Studies have found that young people who use e-cigarettes are more likely to become smokers, and many are low-risk youth who would not have otherwise smoked cigarettes.[41] Both the U.S. Surgeon General and NASEM have concluded that there is an association between e-cigarette use and subsequent cigarette smoking initiation.

  - 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.[42]
  - A 2018 report by the National Academies of Sciences, Engineering and Medicine (NASEM) concluded that "There is substantial evidence that e-cigarette use increases risk of ever using combustible tobacco cigarettes among youth and young adults."[43]
  - One study found that youth who used e-cigarettes were four times more likely to subsequently try cigarettes.[44]

- The concept of "lower risk" absolutely does not apply to youth – any nicotine use by youth is a serious concern.

The Claim that E-Cigarettes are 95% Safer than Cigarettes is Erroneous and is Widely Disputed by Researchers

- This specific claim has serious limitations and has received criticism from different scientific sources:

  - A 2020 AJPH article conclusively refuted the erroneous claim that e-cigarettes have been proven to be 95% safer than regular cigarettes, concluding, "The "95% safer" estimate is a "factoid": unreliable information repeated so often that it becomes accepted as fact."
  - This article notes "the evidence-lacking estimate derived in 2013 cannot be valid today and should not be relied upon further." Since 2013, a substantial amount of new evidence has

emerged about e-cigarettes. The article notes that the devices are now more powerful, create more aerosol, and expose users to more toxicants. The proliferation of e-liquids with nicotine salts allow users to inhale significantly higher levels of nicotine. More research emerged about the toxicants in e-cigarettes, and their potential respiratory and cardiovascular effects.[45]

  - As an editorial from *The Lancet* summarized, "the opinions of a small group of individuals with no pre-specified expertise in tobacco control were based on an almost total absence of evidence of harm. It is on this extraordinarily flimsy foundation that PHE based the major conclusion and message of its report."[46]

- The authors of the original estimate acknowledge they were limited by a "lack of hard evidence for the harms of most products on most of the criteria." The introduction to the article noted that, "our understanding of the potential hazards associated with using electronic nicotine delivery systems (ENDS, e.g. E-cigarettes) is at a very early stage."[47]

- Given that studies continue to raise new concerns about e-cigarettes, the evidence is insufficient to reach definitive conclusions regarding their relative health risk compared to cigarettes. Recent evidence suggests that some risk reductions associated with e-cigarettes may not be as substantial as previously claimed.[48]

Conclusion

While the evidence to date indicates that e-cigarettes expose users to fewer harmful chemicals than traditional cigarettes, the evidence of the harms of these products continues to emerge and the growing body of evidence indicates that they are certainly not safe, especially for kids and others who do not currently use tobacco products.

Campaign for Tobacco-Free Kids, April 4, 2024

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