

The Chemicals in E-Cigarette Aerosol



E-cigarette aerosol is not harmless – it can contain nicotine, toxic chemicals, carcinogens, and ultrafine particles that may pose health risks.

Some of the chemicals identified in e-cigarette aerosol include:

- **Nicotine**¹ – Highly addictive and can harm adolescent brain development.
- **Carbonyl Compounds (i.e., formaldehyde², acetaldehyde³, acrolein⁴)** – Known toxic and irritating properties.
- **Volatile Organic Compounds⁵ (VOCs) (i.e., benzene⁶, toluene⁷)** – Combustion-related byproducts that can cause harm to the body, especially in high doses.
- **Heavy Metals⁸ (i.e., nickel, lead, chromium)** – Inhalation may lead to organ damage.
- **Ultrafine Particles⁹** – Can penetrate deep into the lungs, leading to inflammation and respiratory issues.
- **Tobacco-Specific Nitrosamines¹⁰ (TSNAs)** – Known carcinogens found in many e-cigarette aerosols (however not at levels found in conventional cigarettes).

The contents and levels of chemicals in e-cigarette aerosol can vary widely depending on the ingredients in the e-liquid, device characteristics (i.e., battery power, wick construction), and use patterns.

Even though e-cigarettes generally have fewer toxins than conventional cigarettes,¹¹ researchers are continuing to learn more about the complex mixture of chemicals. For instance, researchers at Johns Hopkins University detected approximately 2,000 chemicals in four e-cigarette brands.¹² The vast majority of these chemicals were unidentified. Another recent study found some popular, newer disposable e-cigarettes released higher amounts of some toxic metals than older e-cigarettes and conventional cigarettes.¹³

Many substances in e-cigarette aerosol are toxic and under-researched. Further research on the long-term effects of exposure to e-cigarette aerosol is crucial to public health.

- ¹ U.S. Centers for Disease Control and Prevention (CDC), About E-Cigarettes (Vapes), October 24, 2024, <https://www.cdc.gov/tobacco/e-cigarettes/about.html>. Accessed May 15, 2025.; U.S. Environmental Protection Agency (EPA), Secondhand Electronic-Cigarette Aerosol and Indoor Air Quality, May 13, 2025, <https://www.epa.gov/indoor-air-quality-iaq/secondhand-electronic-cigarette-aerosol-and-indoor-air-quality#what-is>. Accessed May 15, 2025.
- ² 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>; U.S. Environmental Protection Agency (EPA), Secondhand Electronic-Cigarette Aerosol and Indoor Air Quality, May 13, 2025, <https://www.epa.gov/indoor-air-quality-iaq/secondhand-electronic-cigarette-aerosol-and-indoor-air-quality#what-is>. Accessed May 15, 2025.; Tehrani MW, et al. Characterizing the chemical landscape in commercial e-cigarette liquids and aerosols by liquid chromatography-high-resolution mass spectrometry. Chemical research in toxicology. 2021 Oct 5;34(10):2216-26.; Zwack, LM, et al. Evaluation of Chemical Exposures at a Vape Shop, Atlanta, GA, U.S. Centers for Disease Control and Prevention, 2017, <https://www.cdc.gov/niosh/hhe/reports/pdfs/2015-0107-3279.pdf>; Goniewicz, ML, et al., "Levels of selected carcinogens and toxicants in vapour from electronic cigarettes," Tobacco Control 23(2):133-9, March 6, 2013.
- ³ 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>; Goniewicz, ML, et al., "Levels of selected carcinogens and toxicants in vapour from electronic cigarettes," Tobacco Control 23(2):133-9, March 6, 2013.
- ⁴ 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>; Goniewicz, ML, et al., "Levels of selected carcinogens and toxicants in vapour from electronic cigarettes," Tobacco Control 23(2):133-9, March 6, 2013.
- ⁵ U.S. Centers for Disease Control and Prevention (CDC), About E-Cigarettes (Vapes), October 24, 2024, <https://www.cdc.gov/tobacco/e-cigarettes/about.html>. Accessed May 15, 2025.; Zwack, LM, et al. Evaluation of Chemical Exposures at a Vape Shop, Atlanta, GA, U.S. Centers for Disease Control and Prevention, 2017, <https://www.cdc.gov/niosh/hhe/reports/pdfs/2015-0107-3279.pdf>.
- ⁶ 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>; Tehrani MW, et al. Characterizing the chemical landscape in commercial e-cigarette liquids and aerosols by liquid chromatography-high-resolution mass spectrometry. Chemical research in toxicology. 2021 Oct 5;34(10):2216-26.
- ⁷ Tehrani MW, et al. Characterizing the chemical landscape in commercial e-cigarette liquids and aerosols by liquid chromatography-high-resolution mass spectrometry. Chemical research in toxicology. 2021 Oct 5;34(10):2216-26.; Goniewicz, ML, et al., "Levels of selected carcinogens and toxicants in vapour from electronic cigarettes," Tobacco Control 23(2):133-9, March 6, 2013.
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- ⁹ U.S. Centers for Disease Control and Prevention (CDC), About E-Cigarettes (Vapes), October 24, 2024, <https://www.cdc.gov/tobacco/e-cigarettes/about.html>. Accessed May 15, 2025.; U.S. Environmental Protection Agency (EPA), Secondhand Smoke and Electronic-Cigarette Aerosols, May 13, 2025, <https://www.epa.gov/indoor-air-quality-iaq/secondhand-smoke-and-electronic-cigarette-aerosols>. Accessed May 15, 2025.; Williams, M, et al., "Metal and Silicate Particles Including Nanoparticles Are Present in Electronic Cigarette Cartomizer Fluid and Aerosol," PlosOne, 8(3), March 2013.
- ¹⁰ Goniewicz, ML, et al., "Levels of selected carcinogens and toxicants in vapour from electronic cigarettes," Tobacco Control 23(2):133-9, March 6, 2013.
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- ¹³ Salazar MR, Saini L, Nguyen TB, Pinkerton KE, Madl AK, Cole AM, Poulin BA. Elevated Toxic Element Emissions from Popular Disposable E-Cigarettes: Sources, Life Cycle, and Health Risks. ACS Central Science. 2025 Jun 25.