

## Electronic Smoking Devices and Secondhand Aerosol

Electronic smoking devices (or ESDs), which are often called **e-cigarettes**, heat and vaporize a solution that typically contains nicotine. The devices are metal or plastic tubes that contain a cartridge filled with a liquid that is vaporized by a battery-powered heating element. The aerosol is inhaled by the user when they draw on the device, as they would a regular tobacco cigarette, and the user exhales the aerosol into the environment.

*“If you are around somebody who is using e-cigarettes, you are breathing an aerosol of exhaled nicotine, ultra-fine particles, volatile organic compounds, and other toxins.”* Dr. Stanton Glantz, Director for the Center for Tobacco Control Research and Education at the University of California, San Francisco.

### Current Legislative Landscape

- As of October 1, 2014, [225 municipalities and three states include electronic smoking devices](#) as products that are prohibited from use in smokefree environments.

### Constituents of Secondhand Aerosol

Electronic smoking devices (ESDs) do not just emit “harmless water vapor.” **Secondhand aerosol (incorrectly called vapor by the industry) from ESDs contains nicotine, ultrafine particles and low levels of toxins** that are known to cause cancer.

- ESD aerosol is made up of a high concentration of ultrafine particles, and the particle concentration is higher than in conventional tobacco cigarette smoke.<sup>1</sup>
- Exposure to fine and ultrafine particles may exacerbate respiratory ailments like asthma, and constrict arteries which could trigger a heart attack.<sup>2</sup>
- At least 10 chemicals identified in ESD aerosol are on California’s Proposition 65 list of carcinogens and reproductive toxins, also known as the [Safe Drinking Water and Toxic Enforcement Act of 1986](#). The compounds that have already been identified in [mainstream](#) (MS) or [secondhand](#) (SS) ESD aerosol include: **Acetaldehyde (MS), Benzene (SS), Cadmium (MS), Formaldehyde (MS,SS), Isoprene (SS), Lead (MS), Nickel (MS), Nicotine (MS, SS), N-Nitrosornicotine (MS, SS), Toluene (MS, SS)**.<sup>3,4</sup>
- **ESDs contain and emit propylene glycol**, a chemical that is used as a base in ESD solution and is one of the primary components in the aerosol emitted by ESDs.
  - Short term exposure causes eye, throat, and airway irritation.<sup>5</sup>
  - Long term inhalation exposure can result in children developing asthma.<sup>6</sup>
- Even though propylene glycol is FDA approved for use in some products, the inhalation of vaporized nicotine in propylene glycol is not. Some studies show that heating propylene glycol changes its chemical composition, producing small amounts of propylene oxide, a known carcinogen.<sup>7</sup>

- There are **metals in ESD aerosol, including chromium, nickel, and tin nanoparticles**.<sup>8</sup>
- FDA scientists found detectable levels of carcinogenic tobacco-specific nitrosamines in ESD aerosol.<sup>9</sup>
- People exposed to ESD aerosol absorb nicotine (measured as cotinine), with one study showing levels comparable to passive smokers.<sup>10</sup>
- **Diethylene Glycol**, a poisonous organic compound, was also detected in ESD aerosol.<sup>11</sup>
- **Exhaled ESD aerosol contained propylene glycol, glycerol, flavorings, and nicotine, along with acetone, formaldehyde, acetaldehyde, propanal, diacetyl, and triacetyl**.<sup>12</sup>
- Many of the elements identified in the aerosol are known to **cause respiratory distress and disease**. The aerosol contained particles >1 µm comprised of tin, silver, iron, nickel, aluminum, and silicate and nanoparticles (<100 nm) of tin, chromium and nickel. The concentrations of nine of eleven elements in ESD aerosol were higher than or equal to the corresponding concentrations in conventional cigarette smoke.<sup>13</sup>
- ESDs cause exposure to different chemicals than found in conventional cigarettes and there is a need for risk evaluation for both primary and passive exposure to the aerosol in smokers and nonsmokers.<sup>14</sup>
- Short term use of ESD has been shown to increase respiratory resistance and impair lung function, which may result in difficulty breathing.<sup>15</sup>
- The first study to look at exposure to aerosol from ESDs in real-use conditions found that non-smokers who were exposed to conventional cigarette smoke and ESD aerosol absorbed similar levels of nicotine.<sup>16</sup>
- The “E-cigarettes do not produce a vapor (gas), but rather a dense visible aerosol of liquid sub-micron droplets consisting of glycols, nicotine, and other chemicals, some of which are carcinogenic (e.g., formaldehyde, metals like cadmium, lead, & nickel, and nitrosamines).” ASHRAE concluded that ESDs emit harmful chemicals into the air and need to be regulated in the same manner as tobacco smoking.<sup>17</sup>
- Some chemicals used as flavorings in ESD liquid, which are approved by the FDA for food use (ingestion), are not approved for inhalation and are associated with respiratory disease when inhaled.<sup>18</sup>
- There is a risk of thirdhand exposure to nicotine released from ESD aerosol that deposits on indoor surfaces.<sup>19</sup>
- Overall, ESDs are a new source of **Volatile Organic Compounds (VOCs) and ultrafine/fine particles in the indoor environment**, thus resulting in “passive vaping.”<sup>20</sup>
- The World Health Organization (WHO) recommends that ESDs not be used indoors, especially in smokefree environments, in order to minimize the risk to bystanders of breathing in the aerosol emitted by the devices and to avoid undermining the enforcement of smokefree laws.<sup>21</sup>
- The American Industrial Hygiene Association (AIHA) also recommends that ESDs be included in smokefree laws: “**Because e-cigarettes are a potential source of pollutants (such as airborne nicotine, flavorings, and thermal degradation products), their use in the indoor**

***environment should be restricted, consistent with current smoking bans, until and unless research documents that they will not significantly increase the risk of adverse health effects to room occupants.***<sup>22</sup>

ESD aerosol is a new source of pollution and toxins being emitted into the environment. We do not know the long-term health effects of ESD use and although the industry marketing of the product implies that these products are harmless, the aerosol that ESD emit is not purely water vapor.

***May be reprinted with appropriate attribution to Americans for Nonsmokers' Rights, © 2014***

1402 [FS-39]

## REFERENCES

- <sup>1</sup> Fuoco, F.C.; Buonanno, G.; Stabile, L.; Vigo, P., "[Influential parameters on particle concentration and size distribution in the mainstream of e-cigarettes](#)," *Environmental Pollution* 184: 523-529, January 2014.
- <sup>2</sup> Grana, R; Benowitz, N; Glantz, S. "[Background Paper on E-cigarettes](#)," Center for Tobacco Control Research and Education, University of California, San Francisco and WHO Collaborating Center on Tobacco Control. December 2013.
- <sup>3</sup> Goniewicz, M.L.; Knysak, J.; Gawron, M.; Kosmider, L.; Sobczak, A.; Kurek, J.; Prokopowicz, A.; Jablonska-Czapla, M.; Rosik-Dulewska, C.; Havel, C.; Jacob, P.; Benowitz, N., "[Levels of selected carcinogens and toxicants in vapour from electronic cigarettes](#)," *Tobacco Control* [Epub ahead of print], March 6, 2013.
- <sup>4</sup> Williams, M.; Villarreal, A.; Bozhilov, K.; Lin, S.; Talbot, P., "[Metal and silicate particles including nanoparticles are present in electronic cigarette cartomizer fluid and aerosol](#)," *PLoS ONE* 8(3): e57987, March 20, 2013.
- <sup>5</sup> Wieslander, G; Norbäck, D; Lindgren, T. "[Experimental exposure to propylene glycol mist in aviation emergency training: acute ocular and respiratory effects](#)," *Occupational and Environmental Medicine* 58:10 649-655, 2001.
- <sup>6</sup> Choi, H; Schmidbauer, N; Spengler, J; Bornehag, C., "[Sources of Propylene Glycol and Glycol Ethers in Air at Home](#)," *International Journal of Environmental Research and Public Health* 7(12): 4213-4237, December 2010.
- <sup>7</sup> Henderson, TR; Clark, CR; Marshall, TC; Hanson, RL; & Hobbs, CH. "[Heat degradation studies of solar heat transfer fluids](#)," *Solar Energy*, 27, 121-128. 1981.
- <sup>8</sup> Williams, M.; Villarreal, A.; Bozhilov, K.; Lin, S.; Talbot, P., "[Metal and silicate particles including nanoparticles are present in electronic cigarette cartomizer fluid and aerosol](#)," *PLoS ONE* 8(3): e57987, March 20, 2013.
- <sup>9</sup> Westenberger, B.J., "[Evaluation of e-cigarettes](#)," St. Louis, MO: U.S. Department of Health and Human Services (DHHS), Food and Drug Administration (FDA), Center for Drug Evaluation and Research, Division of Pharmaceutical Analysis, May 4, 2009.
- <sup>10</sup> Flouris, A.D.; Chorti, M.S.; Poulianiti, K.P.; Jamurtas, A.Z.; Kostikas, K.; Tzatzarakis, M.N.; Wallace, H.A.; Tsatsaki, A.M.; Koutedakis, Y., "[Acute impact of active and passive electronic cigarette smoking on serum cotinine and lung function](#)," *Inhalation Toxicology* 25(2): 91-101, February 2013.
- <sup>11</sup> Westenberger, B.J., "[Evaluation of e-cigarettes](#)," St. Louis, MO: U.S. Department of Health and Human Services (DHHS), Food and Drug Administration (FDA), Center for Drug Evaluation and Research, Division of Pharmaceutical Analysis, May 4, 2009.
- <sup>12</sup> Schripp, T.; Markewitz, D.; Uhde, E.; Salthammer, T., "[Does e-cigarette consumption cause passive vaping?](#)" *Indoor Air* 23(1): 25-31, February 2013.
- <sup>13</sup> Williams, M.; Villarreal, A.; Bozhilov, K.; Lin, S.; Talbot, P., "[Metal and silicate particles including nanoparticles are present in electronic cigarette cartomizer fluid and aerosol](#)," *PLoS ONE* 8(3): e57987, March 20, 2013.
- <sup>14</sup> Pellegrino, R.M.; Tinghino, B.; Mangiaracina, G.; Marani, A.; Vitali, M.; Protano, C.; Osborn, J.F.; Cattaruzza, M.S., "[Electronic cigarettes: an evaluation of exposure to chemicals and fine particulate matter \(PM\)](#)," *Annali Di Igiene* 24(4):279-88, July-August 2012.
- <sup>15</sup> Vardavas, C.I.; Anagnostopoulos, N.; Kougias, M.; Evangelopoulou, V.; Connolly, G.N.; Behrakis, P.K., "[Short-term pulmonary effects of using an electronic cigarette: impact on respiratory flow resistance, impedance, and exhaled nitric oxide](#)," *Chest* 141(6): 1400-1406, June 2012.

---

<sup>16</sup> "Cigarettes vs. e-cigarettes: Passive exposure at home measured by means of airborne marker and biomarkers." *Environmental Research*, Volume 135, November 2014.

<http://www.sciencedirect.com/science/article/pii/S0013935114003089>

<sup>17</sup> Offermann, Bud. "The Hazards of E-Cigarettes." *ASHRAE Journal*, June 2014.

[http://bookstore.ashrae.biz/journal/download.php?file=2014June\\_038-047\\_IAQ\\_Offerman\\_rev.pdf](http://bookstore.ashrae.biz/journal/download.php?file=2014June_038-047_IAQ_Offerman_rev.pdf)

<sup>18</sup> Konstantinos E. Farsalinos, KE; Kistler, KA; Gilman, G; Voudris, V. "Evaluation of Electronic Cigarette Liquids and Aerosol for the Presence of Selected Inhalation Toxins." *Nicotine and Tobacco Research* [Epub ahead of print], September 1, 2014.

<sup>19</sup> Goniewicz, M.L.; Lee, L., "[Electronic cigarettes are a source of thirdhand exposure to nicotine](#)," *Nicotine and Tobacco Research* [Epub ahead of print], August 30, 2014.

<http://ntr.oxfordjournals.org/content/early/2014/08/28/ntr.ntu152.abstract>

<sup>20</sup> Schripp, T.; Markewitz, D.; Uhde, E.; Salthammer, T., "[Does e-cigarette consumption cause passive vaping?](#)," *Indoor Air* 23(1): 25-31, February 2013.

<sup>21</sup> World Health Organization (WHO), "Electronic nicotine delivery systems," *World Health Organization (WHO)*, 2014.

[http://apps.who.int/gb/fctc/PDF/cop6/FCTC\\_COP6\\_10-en.pdf](http://apps.who.int/gb/fctc/PDF/cop6/FCTC_COP6_10-en.pdf)

<sup>22</sup> White Paper: *Electronic Cigarettes in the Indoor Environment*, American Industrial Hygiene Association, October 19, 2014.

[https://www.aiha.org/government-affairs/Documents/Electronic%20Cig%20Document\\_Final.pdf](https://www.aiha.org/government-affairs/Documents/Electronic%20Cig%20Document_Final.pdf)