

Electronic Cigarettes

Contents & Potential Harms

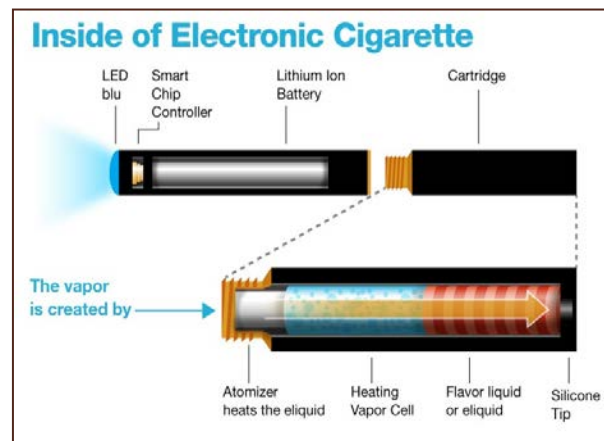


WHAT'S IN AN E-CIGARETTE?

See Table 1: What's in an E-cigarette?

A common ingredient in most e-cigarettes is nicotine. Nicotine (LD_{50} : 3.34mg/kg)¹ is a stimulant and is toxic at relatively low concentrations when compared to other stimulants such as caffeine (LD_{50} : 192mg/kg).² It is the main addictive ingredient in cigarettes and has been considered as addictive as heroin or cocaine.³ Persons under the age of 18 are highly susceptible due to their still developing brains.**Error! Bookmark not defined.**^{4,5} Studies show that nicotine usage at an early age causes changes to the brain and is associated with greater usage during adulthood.⁶ Like most drugs, nicotine usage results in the development of tolerance and a necessity for increased usage. It is also associated with withdrawal symptoms such as anxiety, loss of concentration, tremors, and teeth chattering.⁷ Studies have shown that nicotine may act as a gateway drug for more illicit drugs, such as cocaine.⁸

Inhalation of nicotine quickly distributes the drug into the bloodstream and then the brain.⁶ Nicotine use can produce birth defects through first hand or second hand usage.^{5,9} Nicotine is also readily absorbed through dermal contact and can quickly lead to sickness.¹⁰ While nicotine is not a carcinogen, studies have shown that it may act as a "tumor promoter."¹¹ The amount of nicotine listed on an e-cigarette product has been shown to be inaccurate at times.^{12,13} This is most likely attributable to a lack of quality control standards. It should be noted that all e-cigarette nicotine is derived from tobacco; therefore, e-cigarettes are tobacco products.¹⁴



Nicotine is a toxin and is NOT harmless.

Another common ingredient in e-cigarettes is propylene glycol, which is the component of e-cigs that creates the simulation of cigarette smoke. Propylene glycol is generally regarded as safe as a food additive; however, propylene glycol can produce sore throat, lung and eye irritation, and muscle soreness if inhaled in its gaseous state. This can be particularly dangerous for persons with lung conditions such as asthma.^{15,16} Dow Chemical Company is the world leader of production of propylene glycol and states that it "does not support or recommend the use of PG in applications where inhalation exposure or human eye contact with the spray mists of these materials is likely."¹⁷ Currently there is no long term data on the health effects of inhaling propylene glycol on a regular basis.¹⁸

Flavors such as strawberry, chocolate, cotton candy, grape, peach, cherry, etc., are also commonly found in e-cigarettes. Flavorants that are generally regarded as safe (GRAS) by Section 201 (s) of the Federal Food, Drug, and Cosmetic Act, are only considered safe as food additives. The Flavor and Extract Manufacturers Association (FEMA) warns that e-cigarette flavor additives should not be considered safe due to their FEMA GRAS status. This status is only awarded to flavors meant for human ingestion, not inhalation. They also further warn that the use of occupational exposure limits (OELs), permissible exposure limits (PELs), recommended exposure limits (RELs), and threshold limit values (TLVs) for flavorings are only applicable to workplace conditions and should not be used as indicators of safety for e-cigarettes.¹⁹

Several e-cigarette aerosols have tested positive for toxic substances, volatile organic compounds, tobacco specific nitrosamines, and heavy metals.^{20,21, 22,23,32,33,34} The presence of heavy metals, such as tin, lead, and zinc are most likely attributed to the lack of oversight in the manufacturing of e-cigarette parts. Ninety percent of the world's e-cigarettes are produced in China with little to no quality control standards.²⁴ Carcinogens such as formaldehyde and acrolein have been found in e-cig aerosol to be at similar, but at lower levels than the smoke produced by cigarettes.²⁰

While e-cigarettes may contain and produce fewer toxins than traditional cigarettes, they are not harmless. Without regulations, standards, and long term data; the safety of these products cannot be guaranteed or determined.

HOW ARE E-CIGARETTES HARMFUL TO OTHERS?

SECOND-HAND HARM

See: Table 1: What's in an E-cigarette?

A non-smoker sharing the same air space can smell and see second-hand smoke emitted from traditional cigarettes, which are known to the scientific community to contain toxic and cancer-causing chemicals.⁵ Electronic cigarettes do not emit the same smoke as traditional cigarettes, but similar to traditional cigarettes they can cause second-hand exposure or "passive vaping."



When used, electronic cigarettes emit aerosol that often contains nicotine, ultrafine particles and low levels of toxins, introducing new pollutants into the air.^{25,26} Studies have found that non-smokers who were exposed to passive vaping absorb nicotine (cotinine – a biomarker of nicotine) at significantly higher levels than those who are not exposed to e-cigarettes or traditional cigarettes.²⁷ In fact, the levels of cotinine absorbed by non-smokers exposed to passive vaping are similar to that of traditional cigarettes.^{27,28} The World Health Organization and American Industrial Hygiene Association recommend that electronic cigarettes should not be used indoors or in designated smoke-free environments due to potential harm.^{9,29} San Francisco Health Code 19N prohibits the use of electronic cigarettes in public places wherever the use of cigarettes is prohibited to minimize second-hand harm to others. In addition to potential second hand harms, there is evidence that electronic cigarettes may be a source of thirdhand exposure to nicotine.³⁰



TABLE 1: WHAT'S IN AN E-CIGARETTE?

Without regulations and standards, contents of e-cigarette liquids vary, therefore the makeup of the aerosol emitted varies as well. The following table summarizes some constituents detected in e-cigarette aerosol when researchers measured the vaping and passive vaping of e-cigarettes and lists the potential harm of these constituents.

(Prop 65) indicates that the constituent is listed on the California Prop 65 (Safe Drinking Water and Toxic Enforcement Act) list of chemicals known to the state to cause cancer or reproductive toxicity.³¹ An asterisk () indicates that the constituent was detected in studies examining second-hand harm. IARC = International Agency for Research on Cancer*

Constituents	Source(s)	Potential Harm
Volatile organic compound		
Nicotine*	Goniewicz 2013 ²⁰ , Schripp 2012 ³² , Westenberger 2009 ³³ , Balbe 2014 ²⁷ , Flouris 2013 ²⁵	Reproductive harm; Carcinogenic and Reproductive toxin (Prop 65)
Acetaldehyde*	Schripp 2012, Goniewicz 2013, Hutzler 2014 ¹³ , Kosmider 2014 ²²	Toxic, irritating, possibly carcinogenic as classified as Group 2 based on IARC (Prop 65)
Acetyl Propionyl	Farsalinos 2014	Respiratory disease
Acrolein	Goniewicz 2013	Toxic, irritating to nasal cavity
Diacetyl	Farsalinos 2014 ³⁴	Respiratory disease
Diethylene Glycol	Westenberger 2009	Poisonous organic compound
Formaldehyde*	Schripp 2012, Goniewicz 2013, Hutzler 2014, Kosmider 2014	Toxic, irritating, carcinogenic; carcinogenic and reproductive toxin classified as Group 1 based on IARC
Propylene glycol*	Schripp 2012	Short term irritation of eyes, throat and airways
Toluene	Goniewicz 2013	Carcinogenic and reproductive toxin (Prop 65)
Metals		
Aluminum	Williams 2013 ²¹	Respiratory distress & disease
Boron	Williams 2013	Respiratory distress
Cadmium	Goniewicz 2013	Toxic metal (Prop 65)
Calcium	Williams 2013	Respiratory distress
Chromium	Williams 2013	Carcinogenic, Respiratory disease toxicant, Reproductive development toxicant (Prop 65)
Iron	Williams 2013	Respiratory distress & disease
Lead	Goniewicz 2013, Williams 2013	Carcinogenic, Respiratory disease toxicant, Reproductive development toxicant (Prop 65)
Nickel	Williams 2013	Respiratory distress & disease (Prop 65)
Silicon	Williams 2013	Respiratory distress & disease
Sodium	Williams 2013	Respiratory distress & disease
Tin	Williams 2013	Respiratory distress & disease
Carcinogenic nitrosamines		
NNN	Goniewicz 2013, Westenberger 2009	Carcinogenic and reproductive toxin
NNK	Goniewicz 2013	Carcinogenic nitrosamines

Other important findings from these studies include:

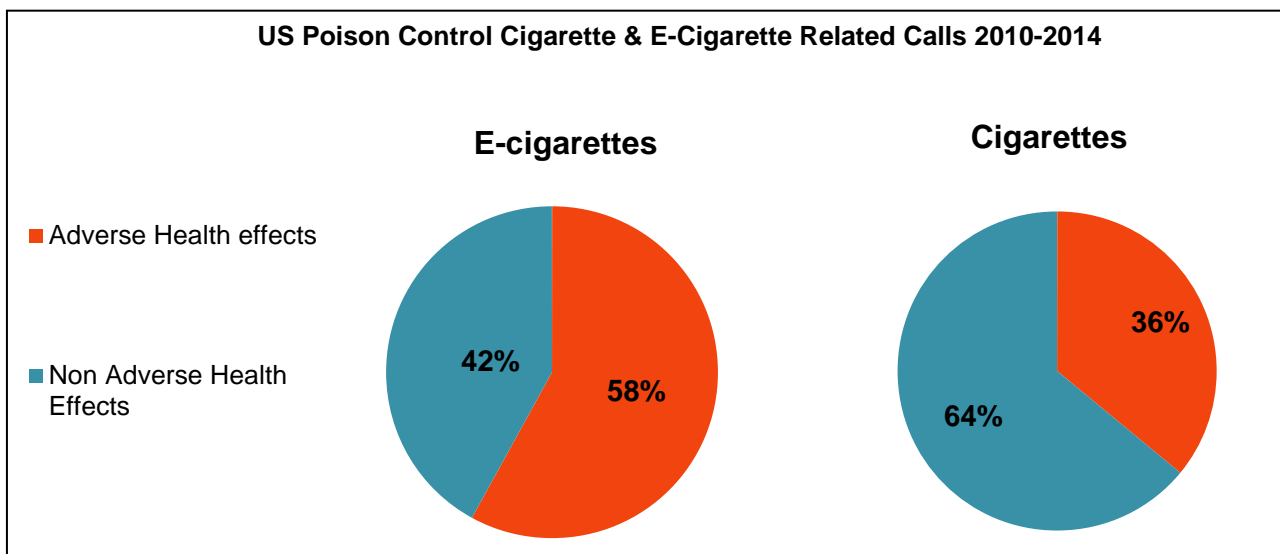
- Goniewicz et al (2013) showed that the following were emitted from the majority of e-cigarette products at significantly higher levels (p<0.05) than that of a nicotine inhalator (reference): formaldehyde, acetaldehyde, acrolein, and toluene. Nicorette inhalator was used as a reference because it is a Food and Drug Administration approved cessation product.
- Williams et al (2013) showed the following were at higher concentration per 10 puffs in electronic cigarette aerosol than in cigarettes: sodium, iron, aluminum, copper, and nickel. All of these metals can cause respiratory distress.
- Farsalinos et al (2014) showed that 47% of samples that contain diacetyl and 41.5% of samples that contain acetyl propionyl exposed people to levels higher than safety limits set by National Institute for Occupational Safety and Health.

NICOTINE POISONING OF CHILDREN FROM E-CIGARETTES

Cases of nicotine poisoning related to electronic cigarettes are dramatically increasing among children, mostly under 5 years old. U.S. poison control centers have seen an increase in calls related to e-cigarettes from 1 per month in 2010 to upwards of 200 per month in 2014. During that same period, among all tobacco-related calls the proportion of e-cigarette related calls increased from 0.3% to 41.6%. More than half (57.8%) of e-cigarette exposure calls reported an adverse health effect in comparison to 36% of cigarette related calls. Common adverse health effects of e-cigarette calls are vomiting, nausea, and eye irritation.³⁵ Currently, there are no standards to require child-proof packaging of e-cigarette cartridges, making it easy for children to access toxic nicotine, which is often colored and flavored.³⁶ E-liquids usually contain nicotine, which if ingested can be lethal; 10 mg or 2 teaspoon dose of nicotine can be fatal to a child. Half a pack of cigarettes contains about 10 mg of nicotine; cartridges of electronic cigarettes contain up to 20 mg of nicotine depending on the brand and type.³⁷ Adults are often unaware that nicotine is toxic and can pose a health hazard to them and their child.³⁸



In December 2014, a one-year-old in New York was the first case of death related to ingestion of liquid nicotine from an electronic cigarette.³⁹ Adult poisonings related to e-cigarettes have also occurred. In Kentucky, 40% of their poison control cases related to e-cigarettes involve adults including one woman who was admitted to a hospital for cardiac problems after she spilled e-liquid and absorbed nicotine through her skin.³⁸



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