Summary of Information about Second-hand Exposure to Vapor from ENDS from the U.S. Surgeon General's 2016 Report

US Department of Health and Human Services. (2016). E-Cigarette use among youth and young adults. A report of the Surgeon General. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.

E-Cigarette Use Among Youth and Young Adults: A Report of the Surgeon General (2016):

"Chapter 3 ("Health Effects of E-Cigarette Use Among U.S. Youth and Young Adults") documents the evidence related to the health effects of e-cigarette use, including those that are associated with direct aerosol inhalation by users, the indirect health effects of e-cigarette use, other non-aerosol health effects of e-cigarette use, and secondhand exposure to constituents of the aerosol." (p. 4)

"The report ends with a Call to Action to stakeholders—including policymakers, public health practitioners and clinicians, researchers, and the public—to work to prevent harms from e-cigarette use and secondhand aerosol exposure among youth and young adults." (p. 4)

Chapter 3:
"Secondhand Exposure to the Constituents of E Cigarette Aerosol [p.] 120"
"Health Effects of Secondhand Exposure to E Cigarette Aerosols [p.] 122"

"Airborne nicotine exposure through secondhand aerosol from e cigarettes has been observed, as has salivary cotinine concentrations of nonsmokers in the homes of e cigarette users (Ballbe et al. 2014; Czogala et al. 2014). Ballbe and colleagues (2014) reported the geometric means of airborne nicotine were 0.74 μg/m3 in the homes of smokers, 0.13 μg/m3 in the homes of e cigarette users, and 0.02 μg/m3 in the homes of nonsmoking controls. While airborne nicotine exposure from combustible cigarette smoke was 5.7 (Ballbe et al. 2014) to 10 times higher (Czogala et al. 2014) than e cigarette aerosol, one study reported only a twofold increase in salivary cotinine (0.38 ng/ml in the homes of smokers versus 0.19 ng/ml in the homes of e cigarette users) (Ballbe et al. 2014), and another study found that exposure to cigarette smoke and exposure to e cigarette aerosol had similar effects on the serum cotinine levels of bystanders (Flouris et al. 2013). Thus, the passive exposure to nicotine from e cigarette smoking has been reported to be just as large (Flouris et al. 2013; Grana et al. 2013) or lower than (Czogala et al. 2014) conventional cigarettes, but exposure to nicotine from e cigarette smoking is not negligible and is higher
than in nonsmoking environments. This evidence suggests the importance of avoiding secondhand exposure of e cigarette vapor and secondhand smoke during pregnancy (Flouris et al. 2013; Grana et al. 2013; Czogala et al. 2014)." (p. 108)

“SIDS. SIDS is the sudden and unexplained death of an infant younger than 1 year of age (Krous 2014). Maternal smoking and infant exposure to secondhand smoke have been causally associated with SIDS, with 20–29% of deaths from SIDS attributable to maternal smoking of conventional cigarettes during pregnancy (Dietz et al. 2010; Zhang and Wang 2013; USDHHS 2014). Prenatal exposure to cigarettes and to smokeless tobacco have been associated with increased risk for apnea events, which have been linked to increased risk for SIDS (Gunnerbeck et al. 2011; Zhang and Wang 2013; Inamdar et al. 2015). (p. 109)

“Health effects not attributable to direct inhalation of e cigarette aerosol include explosion or fire associated with malfunctioned devices, poisoning through contact exposure or intentional or unintentional ingestion of e liquid, and exposure to secondhand aerosol or its condensate.” (p. 119)

“Health Effects Attributable to Explosions and Fires Caused by E Cigarettes
Most reports of explosions and fires caused by e cigarettes have appeared in print and online media and on televised programs. From August 2009 to March 2014, a search of U.S. media by the U.S. Fire Administration (2014) found 25 reports of e cigarette explosions or fires. These data suggest that the number of such events is small when compared with the number of e cigarette users. Of the 25 incidents found in the search, 2 caused serious harm, and there were no deaths attributable to explosions. In most cases, the resulting fires did not spread far from the site of the explosion. However, in one case an entire bedroom was lost to fire (U.S. Fire Administration 2014). As for explosions, several have occurred during an e cigarette’s use, causing severe facial damage or injuries to bodies and hands (Brennan 2015; Corona and Marcus 2015; Duranty 2015; Fox 5 Digital Team 2015; Goff and Schwartz 2015; Jablow and Sexton 2015; Shastry and Langdorf 2016), but most occurred while the device’s batteries were being charged. Overcharging lithium batteries can lead to thermal runaway, causing the e cigarette battery or container to be propelled, often with portions catching fire (U.S. Fire Administration 2014; Bohr et al. in press).” (p. 119)

“Health Effects Caused by Ingestion of E Cigarette Liquids
The liquids in both e cigarettes and the containers used to refill them can cause nicotine poisoning.
Consequences of nicotine intoxication in the e liquid include nausea, vomiting, headaches, dizziness, and diarrhea at low doses; seizures; tachycardia; abdominal pain; confusion; and even death (Cervellin et al. 2013). The amount of nicotine needed to cause death in humans is uncertain and, according to a reevaluation, may be higher than previously thought (Mayer 2014). The total amount of nicotine in refill liquids varies and can be as high as 1,000 mg/10 mL in do it yourself bottles (Davis et al. 2015), which could be lethal if consumed (Mayer 2014). The increase in poisonings prompted enactment of the Child Nicotine Poisoning Prevention Act of 2015 (2016) in January 2016. This law requires any container of liquid nicotine sold, manufactured, distributed, or imported into the United States be placed in special packaging that is difficult to open by children under 5 years of age. Although labels may indicate the concentrations of

nicotine, such labels can be incomplete, confusing, or inaccurate (Trtchounian and Talbot 2011; Cameron et al. 2014), and some bottles have not been labeled at all (Davis et al. 2015). Of most concern, some bottles of e cigarette refill liquids labeled “no nicotine” have been found to contain significant amounts of that substance (e.g., 25.6 mg/mL; Trehy et al. 2011). Regardless, many e cigarette users may not be aware of the toxic effects of nicotine and may not know that refill liquids should be kept away from toddlers and children. These liquids are often sold in colorful bottles with flavors that are attractive to children (Bahl et al. 2012). The liquids usually come in small dropper bottles that can be mistaken for bottles containing food dye or eye drops. Finally, many refill liquids are made in local “vape shops,” which have only recently come under FDA regulation (Federal Register 2016), with no uniform training process for mixers, a lack of standards and protections, and unknown concentrations of nicotine. The rapid growth in popularity of e cigarettes and the ease with which refill liquids can be purchased have made e cigarettes an increasingly common item in many households, thereby elevating the possibility of accidental nicotine poisoning. Instances of related case reports, often involving children or infants, are increasing. For example, an 18 month old girl was treated at an emergency room for hypertension and tachycardia after drinking about 2 mL of refill liquid from a bottle on a nightstand (Shawn
and Nelson 2013). Unintentional exposure to nicotine can occur through ingestion, absorption through the skin, inhalation, or dropping refill liquids into one’s eyes (Cantrell 2014).

Figure 3.2 shows data from 2011 to 2016 on exposures to e cigarettes or liquid nicotine (i.e., any contact with e cigarettes or liquid nicotine, not necessarily resulting in any health effects) (American Association of Poison Control Centers 2016). These data show a dramatic increase in exposures through 2014 with a slight reduction of exposures in 2015. Fifty one percent of the calls to poison control centers regarding exposures to e cigarettes involved children 5 years of age or younger (CDC 2014). Increased e cigarette exposures have also been reported by state and local poison centers (Banerji et al. 2014; Cantrell
2014; Guttenburg et al. 2014; Lee et al. 2014; California Department of Public Health 2015).” (pp. 119-120)

“Secondhand Exposure to the Constituents of E Cigarette Aerosol

Exposure to secondhand smoke from combustible
tobacco products is a known cause of morbidity and mortality (USDHHS 2006). Secondhand smoke, a mixture of the sidestream smoke from a smoldering cigarette and the mainstream smoke exhaled by a smoker, is known to contaminate both indoor and outdoor environments. In addition, when the constituents of smoke deposit on surfaces, nonsmokers can be exposed to them via touch, ingestion, or inhalation. These deposited constituents of combustible smoke are known as “thirdhand smoke” (Matt et al. 2011; Protano and Vitali 2011). E cigarettes represent another potential source of exposure to toxicants for nonusers, via secondhand or thirdhand exposure to aerosol.

Exposure to Nonusers

In contrast to combustible tobacco products, e cigarettes do not produce sidestream emissions; aerosol is produced during activation of the device. Some of this aerosol is subsequently exhaled into the environment where nonusers may be exposed through inhalation, ingestion, or dermal contact. As previously described in this chapter, constituents of the emissions may include nicotine, carbonyl compounds, VOCs, polyaromatic hydrocarbons, TSNAs, heavy metals, and glycols. It is not clear how much of inhaled e cigarette aerosol is exhaled into the environment where nonusers can be exposed. Some studies have used machines to produce e cigarette aerosols and measured the pollutants emitted (McAuley et al. 2012; Czogala et al. 2014; Geiss et al. 2015); others have involved the use by one or more persons of an e cigarette and measured the change in pollutants in either a room or a test chamber after use (Schripp et al. 2013; Schober et al. 2014). One study measured airborne nicotine in the homes of e cigarette users (Ballbe et al. 2014). The concentration of e cigarette aerosol in a given microenvironment depends primarily on the strength of the source or the number of e cigarettes used and the emission rate of the
aerosol for that device. E cigarettes, however, are heterogeneous in their design and in the liquids used, and the specific product combination significantly affects the secondhand emissions (Kosmider et al. 2014; Geiss et al. 2015). The number of puffs and depth of inhalation may be particularly relevant to the amount exhaled by the user and may also affect e cigarette emissions (Talih et al. 2016)."
(pp. 120-121)

"Exposure to E Cigarette Aerosol and Considerations of Dose
A large body of studies has measured exposure to secondhand and thirdhand smoke from conventional cigarettes using personal or area air monitoring, surface testing, and dust testing. Studies of the exposure of e cigarette aerosol to nonusers, however, are limited. Schripp and colleagues (2013) observed small increases of fine and ultrafine particles and some VOCs, including PG,
(pp. 121-122)

"Potential harm also comes from secondhand exposure to the vapor or aerosol expelled from e-cigarette users. Secondhand exposure comes from inhaling the aerosol or contacting vapor-contaminated surfaces. Each of the potential negative consequences of the availability of e-cigarettes could lead to additional disease and premature mortality (Chapter 3)." (p. 183)

"Clean Indoor Air Policies
Clean indoor air or smokefree policies prohibit the use of conventional tobacco products in indoor public places, such as worksites, restaurants, bars, and casinos. Because most of these policies predate the rise of e-cigarettes, their language does not necessarily cover emissions from these products. To protect the public from both secondhand smoke and secondhand aerosol, smokefree air policies should be modernized to include e-cigarettes. Such policies will maintain current standards for clean indoor air, reduce the potential for renormalization of tobacco product use, and prevent involuntary exposure to nicotine and other aerosolized emissions from e-cigarettes (Ingebrethsen et al. 2012; Schripp et al. 2013; Goniewicz et al. 2014;

Offermann 2014; Schober et al. 2014). Updating existing policies to cover e-cigarettes (and all electronic nicotine delivery systems) will eliminate the introduction of airborne toxins into enclosed spaces and establish a uniform standard for preventing the use of both combustible and electronic tobacco products in public and private spaces, including schools, offices, restaurants, bars, casinos, and airplanes. Prohibiting the use of e-cigarettes in enclosed spaces eliminates potential health risks to nonusers and ensures their right to clean air; may discourage the dual use of electronic and combustible tobacco products; simplifies public compliance with and enforcement of existing clean indoor air laws; facilitates reduced consumption of these products; and maintains clear, comprehensive nonsmoking norms (Richardson et al. 2014; World Health Organization 2014a). As of January 1, 2016, six states (Delaware, Hawaii, New Jersey, North Dakota, Oregon, and Utah) had passed comprehensive smokefree indoor air laws that include e-cigarettes (CDC 2015a). These laws prohibit smoking and the use of e-cigarettes in indoor areas of private worksites, restaurants, and bars. Sixteen additional states had prohibited the use of e-cigarettes on some or all state property, and 475 local laws restricted e-cigarette use in 100% smokefree venues (Americans for Nonsmokers' Rights Foundation 2015). Nationwide, more than 400 local jurisdictions prohibit e-cigarette use in 100%-smokefree workplaces (Americans for Nonsmokers' Rights Foundation 2015). Major cities that have addressed e-cigarettes include Austin, Boston, El Paso, Chicago, Los Angeles, Minneapolis, San Francisco, and New York City." (pp. 188)