

# **E-cigarettes in Delaware: An Overview of Concerns of Potential Health Risks & Related Factors**

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## **Abstract**

E-cigarettes and vaporizers (also known as electronic smoking devices or ESDs) are smokeless nicotine products that heat up a propylene glycol or a vegetable glycerin based liquid containing the addictive chemical and various flavenoids to produce a vapor. The devices mimic the effect of true smoking while delivering the nicotine that users crave without causing combustion. These products are comprised of a cartridge, a battery-powered atomizer for heat, and a liquid component (otherwise known as “e-liquid” or “e-juice”). The user presses a button on the device that heats up the atomizer enough to cause the liquid to evaporate without catching fire. The user inhales the vapor through the mouthpiece and delivers the nicotine to their lungs – as well as exhales the visible gas like traditional tobacco products. E-cigarettes are marketed to the public as an alternative to smoking traditional tobacco with the added enjoyment of a wide variety of flavors. The heating components and mechanisms made to release the vapor nor the “e-juice” liquid are regulated by the FDA despite obvious health concerns due to their generally unknown long-term health effects, recent arrival on the market, and skyrocketing popularity in the United States.

## **Introduction**

ESDs were originally invented by a Chinese doctor as a “safer” method of smoking and were to be sold as a prescription to potentially save lives. However, in just one decade, ESDs have become a \$3 billion dollar industry with nearly 500 brands and over 7,700 different flavors being sold over the counter by retailers.<sup>1</sup> According to the federal government, over 2.5 million Americans use e-cigarettes or vaporizers.<sup>2</sup> Entire “vape” shops are sprouting up across the nation, dedicated to the new sub-culture that has been growing as more users arrive. “Vaping” has become more than just a smoking alternative in an attempt to decrease long term health discrepancies: it has become a highly lucrative business and mass-scale hobby.

## **E-Cigarette Attractors**

### **Less Harmful - But Not Harmless**

Some scientists and doctors believe that ESDs have the capacity to save lives and improve the morbidity and mortality of those who are addicted to nicotine and smoke traditional tobacco products like cigarettes and cigars. This is mainly supported by the fact that levels of carcinogenic chemicals found in e-liquid vapors from different flavors have been found by multiple studies to be between 9 and 450 times less than traditional tobacco.<sup>3</sup> As Stanton Glantz, director of the Center for Tobacco Control Research and Education at the University of California, San Francisco states, “There’s no question that a puff on an e-cigarette is less toxic than a puff on a regular cigarette.”<sup>4</sup> In a study on the carcinogenic risks of e-cigarette vapor, the NIH found that “for all byproducts measured, electronic cigarettes produce very small exposures relative to tobacco cigarettes.”<sup>5</sup> Therefore, many proponents of these studies view e-cigarettes as

being far less deleterious to human health in comparison to smoking regular tobacco – and they urge regular users to make the switch if they cannot quit their nicotine addiction entirely.

### **Saving Money**

Some users find that utilizing ESDs can actually help their pockets, as well. An article from Newrepublic.com writer Danny Vinik compared the short-term economic burden of those buying Marlboro Reds cigarettes versus buying the typical ESD starter kit (device) and e-liquid to determine which would save more money in the end dependent on the amount of nicotine the user presumably receives. They used the benchmark that the average smoker would smoke 12 cigarettes per day and would therefore receive approximately 22.8 mg of nicotine per day as well. Graphing the average cost of these products over time (with 22.8 mg of nicotine received by each product per day being constant) yielded the result that e-cigarette users, on average, would begin to save money after their 51<sup>st</sup> day of using their device as opposed to continuing purchasing packs of cigarettes.<sup>6</sup> After the initial investment and cost of e-liquid reaches this point, the user begins to save money each day assuming they take good care of their device. The amount of money saved after this point is also dependent on the user’s vaping preferences and the type of device being used.

### **As A Quitting Device**

According to an American Lung Association fact sheet published in April 2015, “From 2010-2011, 72.0% of people who recently used e-cigarettes also currently smoked conventional cigarettes. That number rose to 76.8% during 2012-2013.”<sup>7</sup> Therefore the vast majority of people using e-cigarettes are also still using traditional cigarettes – which defeats their initial purpose.

Other studies so far have concurred with this fact and also concluded that the majority of people who attempt to make the switch can only do so for a certain period of time before they revert back to traditional tobacco. One article on TIME.com cited a study from the *JAMA Internal Medicine* journal that used self-reports from over 900 smokers in California attempting to make this switch. The study found that e-cigarettes as an alternative were as likely, if not less likely, to help people quit in comparison to other nicotine-replacement methods like nicotine patches or gum.<sup>8</sup> However, the article also cites opponents of this study who claim that this was too small of a sample size and they did not look at e-cigarette usage over a long period of time – therefore ignoring the possibility that switching over to e-cigarettes could be done in a series of attempts, with each successive attempt being more successful.

Other proponents of e-cigarettes who believe that studies such as this are accurate claim that this effect was to be expected. In an article by Nature.com (of the *International Weekly Journal of Science*), Peter Hajek of the Tobacco Dependence Research Unit at the London School of Medicine and Dentistry asserts the idea that ESDs are “the best hope so far to put a stop to smoking-related death and disease by replacing deadly cigarettes with a safer alternative.”<sup>9</sup> He goes on to state that all nicotine replacements will fail at similar rates during short periods of time and studies should be done on a larger scale over longer periods. It is believed by most who are experts in this field that despite the ability of people to switch over to alternatives, they will likely fail without outside support. These methods can be effective if they are coupled with social support and addiction counseling by professionals.<sup>10</sup>

There could be hope for the effectiveness of e-cigarettes considering the mechanisms of how they are used. They mimic the look and feel of traditional cigarettes, which can satisfy the oral

fixation that may couple with peoples' addictions unlike the patch or gum. This makes e-cigarettes an easier, more appealing alternative for traditional smokers to get involved with in order to begin the process of quitting.

There are no regulations or policies yet coordinating how e-cigarette manufacturers can advertise their products – giving way for marketing quotes like, “Blu™ e-cigs are a new kind of satisfaction – without the guilt” and “Take back freedom.”<sup>11</sup>

## **Government Regulations & Tax**

Because of their skyrocketing popularity, e-cigarettes are a hot topic among lawmakers. However, the battle for regulation has been a messy one. The Food and Drug Administration (FDA) has looked into the ability to regulate e-cigarette designs, labeling, and sales; but they are struggling to compile all research available in order to create legislation that does not overstate the harmfulness of these devices that would ruin their market unjustly. One of the main barriers in this fight for regulation arises from the fact that e-cigarettes and ESDs (and their liquid components) were not mentioned in the initial list of known tobacco products under the Tobacco Control Act of 2009, in which the FDA was given the responsibility of all tobacco-related nationwide policy decisions. Some believe that e-cigarettes should be added to the tobacco product category to be primarily regulated until further research can be done to give them their own separate category. Others strongly oppose this notion and believe that it would be a fallacy to do so. The FDA has only officially announced that they will be releasing mandatory rules for how e-liquids are packaged – presumably due to the amount of accidental poisonings in young children tampering with the sweet-smelling products and ingesting and/or spilling it on themselves. The exact policies surrounding this topic are still pending approval and are expected to arrive before the end of 2015.

Delaware has made decisions about ESD public usage and potential for secondhand inhalation issues; the debate now lies in whether or not to tax e-cigarettes like traditional tobacco products. In 2014, e-cigarettes were added to an amendment that labeled them as “tobacco substitutes” under Delaware law, making it illegal to purchase these products unless the customer is at least 18 years of age. Fines for selling to underage customers follow the same guidelines as regular tobacco products for distributing stores. As of July 2015, Delaware added e-cigarettes to their Clean Indoor Air Act, following suit with a majority of other states that have already enacted this policy. Vaping in any public building or state-owned parking lot is now strictly prohibited and treated like regular cigarettes. The only exempt areas are vape shops themselves, who claim that customers need to be able to test their products before they make a purchase. These stores normally use extractive fans to waft out the excess vapor from the building for the benefit of their customers and employees – however this is not yet regulated by law. In addition to the indoor vaping ban, the University of Delaware has made a stand by disallowing the use of vaping and regular tobacco products on any university-owned properties, both for the sake of their students' health, and due to the hazard of fire.

Minnesota and North Carolina are the only two states to have passed legislation calling for e-cigarettes and their liquids to include an excise tax. Eight other states have proposed tax laws on e-cigarettes that have failed to pass. Minnesota assessed a tax rate of 95% of the wholesale price - amounting to approximately \$1.16 billion for the 2014-2015 fiscal year.<sup>12</sup> With such a large sum of money being raked in by the state, new questions have arisen:

## **Why tax?**

Supporters of the tax believe that the increased prices (approximately doubled) will keep these products away from children and teenagers.<sup>13</sup> This follows trend that increased tobacco taxes in the past have caused a drop in their sales and the number of teenagers getting hooked on nicotine. The Centers for Disease Control and Prevention (CDC) supports increased taxation as a means to lower initial tobacco use among teens. Some believe that if they are not taxed at least a little bit and given the “sin tax” connotation, then there is a subconscious message being sent to customers that they are completely safe – which most scientists, doctors, and researchers are afraid will become a public notion that can be detrimental.

## **Where should the tax money go?**

Would the taxes be thrown in with regular tobacco taxes? Would it go towards other state imperatives? Over a billion dollars in tax money is clearly a lot to spend. Though traditional tobacco taxes uses a portion of its income towards funding anti-tobacco advertising and cessation programs, there does not yet seem to be any use for that with e-cigarettes. There is no coordination or studies for these programs to be implemented. States may need more time before they can implement programs related to e-cigarette cessation

The 1998 Federal Master Settlement Agreement requires national tobacco companies to pay more than \$500 billion to assist states in paying for tobacco-related health costs and improving public health. This funding source would be hurt if people were to switch from traditional to e-cigarettes.<sup>14</sup> Policy makers may see e-cigarettes as a threat to state income and view them as a loophole to become addicted to nicotine without being taxed.

## **What are the cons?**

There are numerous reasons why taxation laws have not been passed and why opponents of taxation have reason to fight. First, e-cigarettes have not yet been proven to cause the same levels of mortality and morbidity that regular tobacco products have, giving lawmakers no real reason to impose a “sin tax.” Secondly, some believe that raising prices on e-cigarettes will discourage people from attempting to quit traditional cigarettes. Lastly, taxing them could make way for a significant e-cigarette black market. This is supported by the fact that “in recent years, as much as 40 percent of all cigarettes smoked in New Jersey were smuggled into the state illegally, resulting in a loss of more than \$500 million in uncollected tax revenue each year.”<sup>15</sup>

## **The Problem with E-Cigarettes**

### **Toxicants in the Vapor**

The FDA states that they did “not currently have sufficient data about these products to determine what effects e-cigarettes have on the public’s health.”<sup>16</sup>

Studies have been conducted under many different conditions to test the toxicity of e-cigarette vapor. Though most find that they contain far lower levels of harmful chemicals when compared to regular tobacco smoke, there are still non-zero levels. Health effects from e-cigarettes need to be studied over the course of time to determine the effects of e-cigarette use, and if any of these issues can be prevented. Currently, scientists are studying:

### **High vs. low voltage.**

Most studies have revealed that harmful levels of chemicals are normally higher when ESDs are used at high voltage. The high voltage mechanisms temporarily heat up the liquid to a higher temperature than those with low voltage – and in doing so produce a more concentrated puff, react thermodynamically with the liquid, and release molecules that may not react the same way at lower voltages. The effects of the high voltage can change the chemistry of the vapor just enough as to cause chemical reactions which release higher levels of harmful chemicals into the lungs of the user, and eventually, into the air via secondhand vapor. This can result in additional pleasure when using a high-voltage e-cigarette.<sup>17</sup> Many users who switch to e-cigarettes enjoy the mimicry of thicker vapor that can act like cigarette smoke, which is more likely with higher voltage. High voltage hits are accompanied with larger doses of nicotine per hit, which may reinforce their use.

Although lower dosage vape devices contains a level of hazardous chemical that is, on average, lower than that found in high voltage devices, low voltage e-cigarettes can achieve this large hit effect simply by heating the liquid for a second or two longer than usual.

### **Different flavors**

Different flavors of vape products have varying chemical makeups. All liquids use propylene glycol or vegetable glycerin (or a mixture of both), but the similarities stop there. Flavors and coloring are due to different potential chemicals (and therefore different possible toxicants) that can be inhaled by an e-cigarette user. It is extremely difficult to pinpoint exactly which flavors are the most or least harmful considering the thousands of types available and differences between brands (even for similar flavors). A study published by *The International Journal of Environmental Research and Public Health* found that after testing 20 different commercial e-liquid products, 4 were found to be cytotoxic on cultured myocardial cells.<sup>17</sup> These were not dependent on the brand, but rather on the flavor – meaning that some brands have certain flavors that were very lightly cytotoxic (almost negligible) while some of their other flavors were much more cytotoxic. Table 1 lists harmful chemicals have been observed in e-liquids.

Table 1. Harmful Chemicals Present in E-Liquids<sup>17,18</sup>

Volatile Organic Compounds (VOC)	Non-Volatile Organic Compounds	Inorganic Compounds (including heavy metals)
Acetaldehyde	Nicotine	Aluminum
Acetone	N-Nitrosornicotine	Barium
Acrolein		Boron
Butanal		Cadmium
Crotonaldehyde		Chromium
Formaldehyde		Copper
Glyoxal		Iron
Isoprene		Lead
Methylbenzaldehyde		Magnesium
Xylene		Manganese
Propanal		Nickel
Toluene		Potassium
Valeraldehyde		Tin
		Zinc

		Zirconium Sulfur
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The levels of the VOCs and inorganic compounds were not known to be dangerous at the levels found. Study authors claim that these levels do increase as heating increases, but to levels not expected or suggested by users – deeming those higher levels as unrealistic for vapers to achieve. Traditional cigarette smoke contains these chemicals, and more, at much higher levels (most likely due to combustion and molecular makeup of tobacco leaves).<sup>17,18</sup>

### **Nanoparticles**

In the peer-review medical journal *Circulation*, it was found that ESDs give off high levels of nanoparticles (about the same as regular cigarettes) – which have been directly linked to health effects including, but not limited to, heart disease, atherosclerosis, diabetes, stroke, and asthma.<sup>4</sup> All of these health effects can also coincide with a compromised immune system. This could extend the negative health effects of e-cigarettes into the realm of disease & viral prevention at the population level – just as traditional cigarettes have.

One study done at Boston University claims that e-cigarette vapor caused cells to change their growth rates, due to nanoparticle contamination. The authors observed many of the same genes being turned on and off within their tested cells compared to those tested with regular cigarette smoke.<sup>1</sup>

### **Known Health Effects & Adverse Phenomena**

#### **Propylene Glycol**

Propylene glycol (PG) is a clear liquid solvent used in e-liquid along with vegetable glycerin. It is used in approximately 80% of all e-liquids manufactured today because it gives off a thicker vapor, more preferred by smokers. It also makes it easier to clean out the ESD compared to the less viscous vegetable glycerin. Its other uses in manufacturing include theatrical fog in its vapor form and various types of chemical, food, and pharmaceutical products in its liquid form.<sup>19</sup> The FDA has deemed it “generally recognized as safe” for usage in food products – however they have not tested its toxicity in its vapor form.

Allergy: Some people have reported having allergic reactions upon smoking e-cigarettes that is likely to have been caused by PG. Symptoms ranged from minor to severe and included face and tongue numbness as well as hives on the upper body.<sup>20</sup> People who experienced this effect should switch over to using only 100% vegetable glycerin liquids which has shown there are no known allergic reactions.<sup>21</sup>

Lung Irritant: PG vaped in high quantities can work as a lung irritant and can cause symptoms including (but not limited to) sinusitis, sore throat, nausea, and headache. This could potentially lead to a lowered immune response. Many have reported higher airway agitation associated with e-liquids that are cinnamon flavored.<sup>13</sup>

#### **Asthma**

E-cigarette vapor can be asthma triggers in both primary and secondhand exposures because it can act as an inflammatory agent. An article about secondhand e-cig smoke on No-smoke.org cited a study relating exposure and asthmatic conditions, stating, “exposure to fine and ultrafine

particles may exacerbate respiratory ailments like asthma, and constrict arteries which could trigger a heart attack.” Additionally, they state that, “long term inhalation exposure can result in children developing asthma.”

### **Nicotine Effects / Overdose Poisonings**

According to the CDC, nicotine poisoning from e-liquids can occur in three ways: inhalation, ingestion, and skin or eye absorption.<sup>22</sup>

Though it is difficult to get acute nicotine poisoning through inhalation of e-cigarette vapor with an ESD (it would take hundreds of puffs in a matter of minutes), it can still exacerbate conditions that the user already has and trigger other negative health effects.<sup>23</sup> For example, anyone with COPD or high blood pressure is at increased risk of having a heart attack or difficulty breathing after intake of high levels of nicotine, due to the fact that nicotine is known to constrict blood vessels and elevate blood pressure even further.<sup>24</sup> People with chronic bronchitis also report increased coughing and wheezing accompanied by a tightness in the chest.

The most common type of overdose occurs when someone mishandles an e-liquid bottle and spills it on themselves, or a young child attempts to get into it or eat it. Symptoms include, but are not limited to<sup>25</sup>:

- Abdominal cramps
- Agitation
- Twitching / spasms
- Rapid or difficult breathing
- Burning sensation in mouth
- Coma
- Confusion
- Convulsions
- Drooling
- Fainting
- Headache
- High blood pressure
- Pounding heart
- Vomiting
- Death

These effects are more dangerous and volatile in children. A CDC study found that, “the number of calls to poison centers involving e-cigarette liquids containing nicotine rose from one per month in September 2010 to 215 per month in February 2014,” and “more than half (51.1 percent) of the calls to poison centers due to e-cigarettes involved young children under age 5.”<sup>22</sup> The FDA has not yet completed legislation that would require manufacturers to make child-proof bottles. Also, fruity and candy-like flavors, along with vibrant coloring and sweet smells, entice

kids to open them. A *New York Times* article about the toxicity of these solutions says that e-liquids “are powerful neurotoxins. Tiny amounts, whether ingested or absorbed through the skin, can cause vomiting and seizures and even be lethal. A teaspoon of even highly diluted e-liquid can kill a small child.”<sup>26</sup> In December of 2014, an ABC news report claimed that, according to police reports, a child from New York died from ingesting a parent’s liquid nicotine at their home.<sup>27</sup>

Another concern is for e-liquid handlers and vape shop “bartenders” who concoct mixtures behind a bar for customers to try in the store. They handle the liquids on an everyday basis – and if they are not careful or trained to do so properly, they also run the risk of getting acute nicotine poisoning. Shop owners and managers should take measures to educate their workers to prevent such occurrences.

### **Fires / Overheating**

There have been reports of phenomena with e-cigarettes in which they overheat or overcharge and explode – sometimes causing an electrical fire in the vicinity. Though they are rare, there have been 25 separate documented incidents of this effect since 2009. The Federal Emergency Management Agency (FEMA) compiled these reports and state that:

Media reports generally characterize these incidents as explosions. The event occurs suddenly and is accompanied by a loud noise, a flash of light, smoke, flames, and often vigorous ejection of the battery and other parts. Many of the media reports state that the battery or other components of the device were ejected under pressure and “flew across the room,” often igniting combustible items where they landed.<sup>2</sup>

Researchers from FEMA also believed the sources of these explosions are from overheated lithium ion batteries present in the device, accompanied by a broken switch or faulty USB connection. They often happen while the device is charging, and not while it is in use or in a person’s pocket. These explosions also do not only pose the risk of fire, but also physical injury from the blow, shrapnel from the broken device, and the skin absorption of e-liquid that escapes its cartridge during the event.

E-cigarettes cause fewer fires in comparison to traditional cigarettes, and could lead to the prevention of fires due to regular cigarette disposal. While there have been 25 reported incidents of exploding ESDs over the past 6 years, regular cigarettes are estimated to cause over 100,000 fires per year just in the United States.

### **Addictive Capacity**

Manufactured tobacco products can be some of the most addictive and dependence-producing substances on the market.<sup>28</sup> Nicotine, the addictive substance in tobacco, is a “significant contributor” to both developing and maintaining a smoking habit: its addictive properties are similar to heroin and cocaine.<sup>28</sup> Nicotine is a highly psychoactive drug that affects the brain’s reward systems. Even short-term exposure to nicotine can lead to long-lasting changes in the brain’s reward system.<sup>28</sup> Although there are fewer combustible products in e-cigarettes, nicotine is still being inhaled, and can therefore have the same addictive effect as traditional cigarettes.



Addiction has the potential to cause an economic burden on the user. Although e-cigarettes may become cost-effective for those trying to quit traditional cigarettes, an initial addiction to e-cigarettes poses a drain on the finances of the previous non-smoker, to say nothing of the potential downstream healthcare costs associated with long-term usage.

The percentage of nicotine-addicted users of tobacco products is higher among those living below the poverty line,<sup>29</sup> and cigarettes (or e-cigarettes) can pose a substantial drain on income. The Public Health and Policy Research program found that smokers in New York State who earned less than \$30,000 per year were spending up to a quarter of their income on cigarettes.<sup>30</sup> The earlier a person starts using a tobacco product, the more of their income these products will ultimately end up costing.

### **Gateway Drug**

Are e-cigarettes a gateway drug? If a young person becomes addicted to the nicotine in e-cigarettes, will they ultimately transition to a traditional cigarette for the nicotine hit? Because they may be seen as “safer” than regular tobacco, an e-cigarette may be the first contact a young person has with addictive substances. This could lead to trying and/or abusing other substances, most notably alcohol and marijuana. Alcohol is legal for those over the age of 21, and has the similar “if it is legal, it must be safe” connotation. Marijuana can be smoked, much like an e-cigarette, and its use has been decriminalized in several states.

## **E-cigarettes and Children/Teens**

### **Increased popularity**

The American Lung Association (ALA) states that:

- E-cigarette use among both high school and middle school students has increased, tripling from 2013 – 2014 (4.5% to 13.4%, high school; 1.1% to 3.9%, middle school)
- Almost 1 in 10 former and 1 in 3 current cigarette smokers have used an e-cigarette in 2013 (increased from 2011)
- Youth e-cigarette use has surpassed youth use of traditional cigarettes

Approximately half of young adults today admit that they are willing to try an e-cigarette if a friend offered it to them.<sup>31</sup>

### **Flavoring**

There are over 7,700 flavors available on the market today and that number is still growing – filling the demand for almost every flavor imaginable that a person could possibly want.<sup>1</sup> Sweet tastes and names that resemble candy-like products are a concern because they can attract the attention of youth. Traditional cigarettes had the unique scent and flavor of burning tobacco that was considered unattractive or off-putting. The secondhand smoke from e-cigarettes can become a factor in enticing youth to try them due to their sweet scents (bubblegum, blue raspberry, pink lemonade, etc.).

## Advertising

Advertising for e-cigarettes is currently unregulated. Past studies have indicated that most people do not pick up the habit of smoking cigarettes after age 25: most people will pick up their nicotine addiction before 25, as either a teen or young adult.<sup>32</sup>

What is known about e-cigarettes is both troubling and familiar. The industry, which includes the three major tobacco companies as well as newcomers, is using its old tricks to market the devices and rewrite laws to their liking. While industry players repeat the mantra that e-cigarettes are only for adults, their marketing says the opposite. It includes the same sexy and rebellious images, celebrity users and pitches at sports and music events that helped addict generations of young smokers.<sup>33</sup>

From 2011 to 2013, youth exposure to e-cigarette television advertisements (ages 12 to 17) increased over 250%.<sup>34</sup> These advertisements appeared 76% of the time on six different networks (AMC, Comedy Central, and VH1, all with a high percentage of teenage viewers). Blu™ E-cigarette company sponsored the last FIFA World Cup, airing a music video portraying popular celebrities with e-cigarettes and other products. Researchers are noting that many e-cigarette companies are using the same tactics that Big Tobacco used decades ago, which resulted in youth becoming addicted (despite the age limit of 18 years required to buy tobacco products). Online shopping, in which children can pose as adults online and use a credit card to order vaping products, is another factor.

There is no state-offered education available for e-cigarette retailers in Delaware regarding keeping products out of the hands of minors. Some retailers have attempted to use general tobacco distributing guidelines, and have obtained a tobacco license in the absence of anything specific.

## Parental Concerns

### Second Hand Smoke

Many parents who smoke traditional tobacco products may attempt to quit once they have children due to known effects of secondhand smoke. Some may switch to e-cigarettes, believing this risk has been eliminated. Studies have shown that nicotine exhaled after using an e-cigarette (though at lower levels, due to most of the substance being inhaled by the user) can still have an effect on others in the immediate surroundings, especially children. Young children and infants with developing brains are at risk for neural complications: nicotinic acetylcholine receptors (nAChRs) regulate critical aspects of brain maturation during the prenatal and early postnatal periods, and can affect the limbic system as well as other bodily functions in adolescents that can lead to increased impulsivity and mood disorders.<sup>35</sup>

### Third Hand Exposure

Third hand exposure to substances like VOCs, nicotine, and nanoparticles occurs when these substances are deposited on surfaces (furniture, carpets, clothes, etc) after exhaling the vapors from an ESD aerosol. For this reason, public health officials and the World Health Organization (WHO) have strongly recommended that e-cigarettes not be used indoors, which has led many

public facilities in the nation to amend their smoke-free indoor air policies to include vaping and vaping products.

## Pregnancy

Nicotine exposure has been studied and proven to cause feeding problems, and delayed physical and mental development in infants and children. Prenatal nicotine exposure can also lead to memory loss, impaired senses, Sudden Infant Death Syndrome (SIDS), Attention Deficit Hyperactivity Disorder (ADHD), and substance abuse as a child ages.<sup>35</sup>

## Behavioral Influence

Parents may quit using traditional cigarettes due to their children, but a parents' use of e-cigarettes may also influence their children to use these devices instead. Twelve year old children of tobacco users were more than twice as likely to use tobacco themselves than children with non-smoking parents.<sup>36</sup> Children of adults who began smoking later in life were 29% more likely to smoke.<sup>37</sup> Children of current and former smokers face an overall elevated risk of becoming smokers themselves.<sup>37</sup> Using e-cigarettes instead of tobacco may be a step in the right direction, but parents should still avoid using them in front of their children to avoid normalizing this behavior.

## Conclusion

E-cigarettes and ESDs have not been proven to be safe. Though most experts agree they have the potential to be less harmful than traditional cigarettes, and can be used as a means to quit slowly, there are mounting concerns about the risks involved. Many people may be drawn to ESDs, as they mimic traditional cigarette smoking, but they also draw children and teens with their flavored vapor and sweet taste. The nicotine within an ESD is just as addictive as nicotine found in traditional tobacco, and the economic and social consequences that come with an addiction are just as harmful. Potential health risks of e-cigarette use are still being studied, and ESDs should not be considered a "safe" alternative to traditional tobacco.

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