

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, referred to 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. Despite health concerns related to E-cigarettes, due to factors such as generally unknown long-term health effects, a recent arrival to the market of smoking related products, and skyrocketing popularity in the United States, neither the heating components and mechanisms made to release the vapor, nor the “e-juice” liquid, are regulated by the FDA.

Keywords: electronic cigarettes, e-cigarettes, electronic smoking device, vaping

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Introduction

Electronic smoking devices were first developed in 2003, by a Chinese pharmacist, Han Lik, as a “safer” method of smoking and were to be sold as a prescription to potentially save lives. However, in just one decade ESDs became a three billion dollar industry with nearly 500 brands and over 7,700 different flavors being sold over the counter by retailers (Rimer, 2015). According to the federal government, over 2.5 million Americans use e-cigarettes or vaporizers (FEMA, 2014). With the increase in popularity of these devices, entire “vape” shops have been established across the nation dedicated to the growing sub-culture. “Vaping”, a newly coined term to describe the use of an ESD, has become more than just a smoking alternative in attempt to decrease long term health discrepancies; it has become a highly lucrative business and mass-scale hobby.

Less Harmful, But Not Harmless

Some scientists and doctors believe that ESDs have the capacity to save lives and reduce morbidity and mortality rates amongst those addicted to nicotine and those who use traditional tobacco products like cigarettes and cigars. This belief is mainly supported by the fact that multiple studies have found carcinogenic chemicals in vapors from different e-liquid vapors to be between 9 and 450 times less prevalence than in traditional tobacco (Cheng, 2014). Stanton Glantz, director of the Center for Tobacco Control Research and Education at the University of California, San Francisco, noted in response to the discussion, “There’s no question that a puff on an e-cigarette is less toxic than a puff on a regular cigarette,” (Raloff, 2014). Similarly, according to a study published by the National Institutes of Health on the carcinogenic risks of e-

cigarette vapor, it was found that “For all byproducts measured, electronic cigarettes produce very small exposures relative to tobacco cigarettes,” (McAuley et al, 2012). As a result of these studies, many proponents of ESDs view cigarettes as being far less deleterious to human health in comparison to smoking regular tobacco; if regular tobacco users cannot quit completely, these proponents urge them to at least switch from traditional tobacco products to ESDs.

Cost Savings

An additional benefit of ESDs experiences by some users is cost savings. In an article from Newrepublic.com, writer Danny Vinik compared the short-term economic burden of buying Marlboro Reds cigarettes with the short-term burden of buying a typical ESD starter kit (including device and e-liquid). The two were compared to determine which would result in a greater cost savings based on the same nicotine intake per user. The benchmark used was 12 cigarettes per day for the average smoker, or approximately 22.8mg of nicotine per day. Graphing the average cost of an ESD and traditional cigarettes over time (using 22.8mg of nicotine per day as the standard measurement) yielded a cost savings for ESD users over traditional cigarettes on the 51st day of usage (Vilnik, 2014). At this point in use, ESD users begin to save money each day forward, assuming the device is well maintained. Other determinants of cost savings include vaping preferences and the type of device being used.

Smoking Cessation and EDSs

According to a fact sheet published by the American Lung Association 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,” (King et al, 2014). With the vast majority of e-cigarette users continuing to use traditional cigarettes as well, these figures disprove the efficacy of e-cigarettes as a successful means of achieving cessation.

Other studies have further concluded 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. An 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 the switch from traditional to e-cigarettes. 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 (Sifferlin, 2014). However, opponents of the study cite limitations such as sample size that is too small and no examination of e-cigarette use over an extended period of time, ruling out the potential for examining multiple attempts at switching smoking methods.

Other proponents of e-cigarettes believe the outcomes found in the California study are accurate and were 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,” (Cressey, 2014). 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. Most experts argue that although smokers are able to switch from traditional smoking to e-cigarettes, their ability to quit smoking entirely without outside support is not likely to succeed. Use of e-cigarettes, coupled with other methods, such as social support and addiction counseling, may prove effective however (Opar, 2013).

One of the biggest reasons people are still holding out hope that e-cigarettes will help users quit, is because these devices mimic the look and feel of traditional cigarettes. This sensation of smoking, can satisfy the oral fixation that may couple with peoples’ addictions as

opposed to other alternatives like the patch or gum. As a result, this makes e-cigarettes an easier, more appealing alternative for traditional smokers to get involved with in order to begin the process of quitting.

Government Regulations and Tax

Due to an increase in popularity, e-cigarettes have become a hot button issue amongst lawmakers, and the debate over their regulation has grown complex. The FDA has considered assuming oversight of e-cigarette design, labeling, and sales regulation, however, compiling all available research in order to create legislation that does not overstate the potential harm of these devices has proved challenging. 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 this act, the federal government placed all tobacco-related nationwide policy decisions under the responsibility of the FDA. 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, indeed, be releasing mandatory rules for how e-liquids are packaged. Other reasons for creating these guidelines include the number of children accidentally poisoned by these sweet-smelling products. The exact policies surrounding this topic are still pending approval and are expected to arrive before the end of 2015.

As for state regulations, Delaware has made decisions regarding e-cigs, public usage, and secondhand inhalation issues. Currently the debate has shifted to whether or not there should be taxes for e-cigarettes, similar to taxes for 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 areas exempt from this act are vape shops, which state 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 regulated by law yet. In addition to the indoor vaping ban, the University of Delaware acknowledged their lack of support for these devices, by banning their use (along with regular tobacco products) on any university-owned properties for the sake of their students’ health and possibility of fire hazards.

When it comes to taxation, 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 (Briant, 2015). With such a large sum of money now being amassed by the state, new questions have come into discussion about if e-cigarettes should be taxed or not.

Reasoning. Supporters of the tax believe that the increased prices will keep these products away from children and teenagers (Eversmoke™, n.d.). This belief due to an increase in tobacco taxes, which in the past have caused a drop in their sales and decrease in number of teenagers becoming dependent on nicotine. Other supporters of this taxation as an

attempt to lower tobacco use amongst teens include the CDC. 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? Over a billion dollars in tax money is a considerable amount. Though traditional tobacco taxes use a portion of their income towards funding anti-tobacco advertising and cessation programs, currently there are no similar programs focused on e-cigarette specific behaviors for funds which could be allocated towards programs such as these. There is not enough coordination or studies for these programs to be implemented for e-cigarettes. As a result of the federal Master Settlement Agreement, since 1998, national tobacco companies are paying more than \$500 billion to assist states in paying for tobacco-related health costs and improving public health, it is clear that people switching from traditional cigarettes to e-cigarettes would end up hurting this funding source by hurting tobacco companies themselves (Gleason, 2015). Policy makers may see e-cigarettes as a threat to state income and another way for users to become dependent on nicotine, without experiencing the financial burden of taxation. Furthermore, there would be additional questions to answer, such as where the tax money would be go, if funds would be grouped together with regular tobacco tax funds, or if money would go towards other state imperatives; these are some of the questions which have led other policy makers to oppose an e-cigarette tax.

Opposition. There are numerous reasons why taxation laws have not been passed. 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” just yet.

Secondly, some believe that raising prices will discourage people from attempting to quit traditional cigarettes to switch over to e-cigarettes. This may be a possible outcome, as currently the largest demographic of traditional cigarette users are low-income individuals. Taxes for e-cigarettes may result in these devices becoming commodity items, fiscally out of reach for many users, resulting in a continued use of the cheaper alternative, traditional cigarettes. Lastly, taxing ESDs could lead to the creation of a black market and an underground economy where these device could be sold illegally without taxes. As explained by Chakraborty, “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,” (Chakraborty, 2014).

Toxicants in E-cigarette Vapor

High vs. Low Voltage

Testing on toxicant levels throughout most studies have revealed harmful levels of chemicals are more prevalent 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 – in doing, the device produces a more concentrated puff, and a thermodynamic reaction with the liquid that changes molecules in a different way than when used at a lower voltage. Use at a 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 information about health effects and voltage is critical for those who are avidly vaping because “Consumers report perceiving additional pleasure from high-voltage EC use,” (Farsalinos et al, 2013). Many users who switch to e-cigarettes enjoy how the vapor produced with these devices mimics smoke produce from a cigarette. The higher the voltage of

the e-cigarette, the more vapor one can produce. In turn, this larger amount of vapor, translates into a thicker cloud that is produced by user, a sensation leaving many ESD leaning towards higher voltages. Also, high voltage hits are accompanied with larger doses of nicotine per hit that can reinforce this behavior among vapers. Even for e-cigarettes calibrated at low voltages, users can still receive a larger hit by simply holding down the heating button for a second or two longer. Conducting tests at high voltage follows the principle assuming low voltage vapor will also contain some of these chemicals, however, in lower doses.

Different Flavors

Another factor that must be addressed is also the varying chemical makeups among flavors. Though all e-liquids use propylene glycol or vegetable glycerin (or a mixture of both), flavors and coloring are created by separate, potentially toxic, chemicals. It is extremely hard to pinpoint exactly which flavors are the most or least harmful considering the thousands of types available and their differentials even between brands with similar flavors. In a study published by *The International Journal of Environmental Research and Public Health*, it was found that after testing 20 different commercial e-liquid products, 4 were found to be cytotoxic on cultured myocardial cells (Farsalinos et al, 2013). These results were not dependent on the brand, but rather on the flavor. Tests concluded that one brand may have certain e-liquid flavors with negligible levels of cytotoxicity, but some of the other flavors produced by this same brand, may have considerable levels of cytotoxicity. This makes it difficult to conclude that certain e-liquids are more or less harmful than others, until every ingredient, and the chemicals given off in vapor from all flavors, are methodically assessed. Examples of harmful chemicals observed in some e-liquid flavors during scientific tests include the following compounds in Table 1:

Table 1

<ul style="list-style-type: none"> • Volatile Organic Compounds: VOCs • Acetaldehyde • Acetone • Acrolein • Butanal • Crotonaldehyde • Formaldehyde • Glyoxal • Isoprene • Methylbenzaldehyde • Xylene • Propanal • Toluene • Valeraldehyde • Non-volatile Organic Compounds: • Nicotine • N-Nitrosornicotine 	<ul style="list-style-type: none"> • Inorganic Compounds (Including Heavy Metals): • Aluminum • Barium • Boron • Cadmium • Chromium • Copper • Iron • Lead • Magnesium • Manganese • Nickel • Potassium • Tin • Zinc • Zirconium • Sulfur
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(Farsalinos et al, 2013)

(University of California, San Francisco, n.d.)

There are over 7,700 flavors available on the market today and that number of flavors is still growing (Rimer, 2015). However, sweet tastes and names that resemble candy-like products are now creating concern as they attract youth. As for traditional cigarettes, the burning of tobacco had its own unique scent, which most non-smokers traditionally find off-putting. When it comes to e-cigarettes, secondhand smoke can be responsible for enticing youth to try them due to their sweet scents.

Nanoparticle Argument

Another factor in the discussion about the health effects of e-cigarettes, is the level of nanoparticles given off by these devices. In the peer-review medical journal *Circulation*, it was found that ESDs give off high levels of nanoparticles, which have been directly linked to health

conditions including, but not limited to, heart disease, atherosclerosis, diabetes, stroke, and asthma (Raloff, 2014). All of these health outcomes can result in a weakened immune system. The negative health effects stemming from e-cigarettes may in turn into the realm of disease & viral prevention at the population level – just as traditional cigarettes have.

One study done at Boston University found that e-cigarette vapor did, indeed, cause cells to change their growth rates. This could have been caused by nanoparticle contamination because these types of particles can permeate the nuclei of cells relatively easy compared to other toxicants found to be present. They said that they observed many of the same genes being turned on and off within their tested cells compared to those tested with regular cigarette smoke. Both displayed similar genomic effects – raising the concerns of the researchers. They did not say that this definitely meant that they cause cancer, however it was an interesting find that lead them to believe that other conditions that traditional cigarettes cause could be caused, too, by e-cigarettes (Rimer, 2015).

Known Health Effects and Adverse Phenomena

Propylene Glycol

Propylene glycol (PG) is a clear liquid solvent used in e-liquids along with vegetable glycerin. It is used in approximately 80% of all e-liquids manufactured today because it gives off a thicker vapor, preferred by smokers. Propylene glycol has a thinner than vegetable glycerin, which can cause build up and make it difficult to clean the device. Other uses in manufacturing include theatrical fog in vapor form and various types of chemical, food, and pharmaceutical products in liquid form (Agency for Toxic Substances and Disease Registry, 2011). The FDA has deemed it “generally recognized as safe” for usage in food products, however, they have not tested toxicity in vapor form.

Allergy. Some people have reported having allergic reactions upon smoking e-cigarettes that are likely to have been caused by PG. Symptoms range from minor to severe and include face and tongue numbness as well as hives on the upper body (Al Jasser et al, 2011). People who experienced this effect should switch over to using only 100% vegetable glycerin liquids which have proved no known allergic reactions (CanadaVapes, 2015).

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. These symptoms also create the potential for lowered immune responses. Many have reported higher airway agitation associated with e-liquids that are cinnamon flavored (Eversmoke™, n.d.).

Asthma. E-cigarette vapor can act as an inflammatory agent and create asthma triggers during both direct and secondhand exposures. An article on No-smoke.org discussing a study examining the relationship between exposure and asthmatic conditions, stated “Exposure to fine and ultrafine particles may exacerbate respiratory ailments like asthma, and constrict arteries which could trigger a heart attack,” (Americans for Nonsmokers’ Rights, 2015). Most concerning, is the effect of smoke exposure on children. According to Americans for Nonsmokers Rights, “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 (CDC, 2014). Though it is difficult to experience acute nicotine poisoning through inhalation of e-cigarette vapor, the ESD can still exacerbate health conditions already prevalent in the user. (Wagner, 2014). 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 (Gromisch, 2013). People with chronic bronchitis also report increased coughing and wheezing accompanied by tightness in the chest.

Overdose

The majority of overdoses have occurred due to mishandling of e-liquids, or tragically, through the unintentional poisoning of children playing with e-liquids. Symptoms include, but are not limited to those listed in Table 2:

Table 2

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

(U.S. National Library of Medicine, 2013)

These symptoms can be particularly dangerous, and sometimes fatal, in children. A CDC study published in the *Morbidity and Mortality Weekly Report* in February 2014 stated, “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... [with] More than half (51.1 percent) of the calls to poison centers due to e-cigarettes involved young children under age 5,” (CDC, 2014). Unfortunately, the FDA has not yet completed legislation that would require manufacturers to make child-proof bottles. Also, fruity flavors, along with vibrant coloring and sweet smells, attract children to these bottles. 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,” (Ritchel, 2014). In December of 2014, an ABC news report claimed that a child from New York died from ingesting a parent’s liquid nicotine at their home (Mohney, 2014). As a result of these accidental poisonings and preventable health issues, the FDA has shifted its focus to regulating e-liquid packages, e-cigarette packages, and labeling.

Another population at risk is employees handling e-liquids on a daily basis at vape shops, often called “bartenders”. Bartenders concoct mixtures of different e-liquids behind a bar for customers to try in the store. They handle the liquids on an everyday basis, and without proper training, they also run the risk of getting acute nicotine poisoning. It is important for shop owners and managers should take the time to appropriately educate their worker on proper handling to prevent such occurrences.

Fires / Overheating

There have been reports of phenomena with e-cigarettes in which they overheat, overcharge, or 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. FEMA compiled these reports and state in an online PDF publication on e-cigarettes and fires:

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.

(FEMA, 2014).

Researchers from FEMA also believe causes of these explosions are due to overheated lithium ion batteries present in the device, accompanied by a broken switch or faulty USB powering connection. These explosions often happen while the device is charging rather than when in use. They also do not only pose the risk of fire, but potential for physical injuries from the blow, shrapnel from the broken device, and skin absorption of e-liquid that escapes its cartridge during the event.

Although e-cigarettes cause fewer fires in comparison to traditional cigarettes, these incidents should not be discounted. One way to reduce the number of these situations caused by e-cigarettes is to prohibit littering of combusting elements.

E-cigarettes and Adolescents

Increased popularity

According to a fact sheet from the American Lung Association on e-cigarettes published in April 2015:

- “E-cigarette use among both high school and middle school students tripled in one year, increasing from 4.5 percent in 2013 to 13.4 percent in 2014 among high school students, and from 1.1 percent in 2013 to 3.9 percent in 2014 among middle school students.”
- “In 2013, close to 1 in 10 former and more than 1 in 3 current cigarette smokers had used an e-cigarette, which was an increase compared to 2011 for both groups.”

- “In only a few years of being on the market, youth use of e-cigarettes has now surpassed youth cigarette smoking.”

According to a study cited in a USA Today article, approximately half of young adults today admit that they are willing to try an e-cigarette if a friend offered it to them (Koch, 2012). Health officials are now concerned this could become a major problem down the road due to the sheer incidence of youth using tobacco products.

Advertising

Advertisements are also an area of concern with e-cigarettes and a gap of information about health issues stemming from these devices continues to exist. As of right now, advertising for e-cigarettes is unregulated. Past studies have also indicated that most people do not pick up the habit of smoking cigarettes after age 25, leaving us to conclude that most people will pick up their nicotine addiction before this age as either a teen or young adult (Mascarelli, 2014).

According to an article by USA today on teen usage of e-cigarettes:

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.

(USA Today Editorial Board, 2015)

Statistics have demonstrated these advertisements are affecting youth and their decisions to try e-cigarettes. From 2011 to 2013, youth exposure to e-cigarette television advertisements

(ages 12 to 17) increased over 250% (Healy, 2014). In terms of their overall airing, these ads were shown 76% of the time on six different networks; three of these networks, AMC, Comedy Central, and VH1, all maintain a high percentage of teenage viewers. Blu™ E-cigarette company was also a sponsor during the last FIFA World Cup in which they aired a music video as a build-up to matches portraying popular music celebrities using their products. Due to a lack of regulations, companies are able to use advertising messages such as : “Blu™ e-cigs are a new kind of satisfaction – without the guilt” and “Take back freedom” (Blu™ E-cigarette Company, n.d.).

Researchers are accusing most e-cigarette companies of using the same tactics utilized by big tobacco companies to acquire youth users. Despite the purchase of these devices being illegal for those under 18, many adolescents will still develop a habit and be influenced by advertisements. Furthermore, these products are also available to purchase online. Many adolescents have found ways to pose as adults online and purchase these devices as opposed to trying to buy them in person.

In Delaware there is no state-offered educational piece available for e-cigarette retailers giving their clerks guidelines or licenses on how to make sure that their products are staying out of the hands of children. Some retailers attempt to use the general tobacco distributing guidelines and have a simple tobacco license.

Addictive Capacity

According to the NIH, “Clinicians, behavioral scientists, researchers, and public health experts have increasingly recognized manufactured tobacco products as some of the most addictive and deadly dependence-producing substances available...Little debate exists that nicotine is a significant contributor to the development and maintenance of the smoking habit. In

most aspects of dependence, nicotine is on par with other powerfully addictive drugs, such as heroin and cocaine,” (Prabhat Jha et al, 2006).

This is because nicotine is a highly psychoactive drug that affects the brain’s reward systems by turning certain receptors on and off – such as those that control dopamine and can alter mood. The NIH also states from the tobacco addiction study they looked at that, “Even a short-term exposure to nicotine has been shown to induce long-lasting changes of the excitatory input into the brain’s reward system, which may be an important early step in the path to addiction,” (Prabhat Jha et al, 2006). Youth often don’t think about the future of their health, and believe using these products will not produce the same effects as traditional cigarettes.

An addiction to e-cigarettes has the potential to cause a large economic burden on users throughout the years. Teens that become addicted to nicotine through e-cigarettes may end up spending money on nicotine-containing products for years afterwards. Even though they can end up becoming cost-effective for those trying to quit traditional cigarettes, they create a new financial burden for those who were not spending money on them previously. Rather, they have the potential to cause the user to spend thousands of dollars over time – and that is not including possible healthcare costs that might be associated with long-term usage. It is important to remember that the percentage of nicotine-addicted users of other tobacco products is higher among those living below the poverty line (CDC, n.d.). In New York state, for example, a study from the Public Health and Policy Research program of the non-profit RTI claims that “Smokers in New York State earning less than \$30,000 a year spent 25% of their income on cigarettes,” (Thompson, 2012). Youth that begin this habit are more likely to spend a large percentage of their income on nicotine products in the future – and for those near the poverty line or below it

(which tend to have nicotine addictions more frequently), it can suck out a large proportion of their annual income and further deepen their poverty status.

Gateway Drug

E-cigarettes can become a gateway to other drugs. Developing a nicotine addiction from e-cigarette use can lead to young adults switching to traditional cigarettes, as another means of attaining nicotine. This addiction could make users curious to try other drugs, such as alcohol or marijuana. Alcohol, for example, may have similar connotations that could entice an e-cigarette, such as being legal and portrayed as safe. Similarly with marijuana, which has now been decriminalized in the state of Delaware, is now semi-legal and provides the same smoking sensation as an e-cigarette. The perception that legality can make something less harmless, with the aforementioned drugs, as well as e-cigarettes, is one that could be influential on decision making, particularly in adolescents.

Parental Concerns

Many parents who smoke traditional cigarettes, particularly those with young children may attempt to quit because of the known effects of second hand smoke. Some parents will try to make the switch to e-cigarettes believing ESDs will eliminate all effects of secondhand smoke on their children. Studies have shown these effects will still be present, and vaping in the presence of children is not advised. Children should not be exposed to trapped vapors indoors from e-cigarettes and parents should avoid using ESDs inside at all times despite the notion that vaping indoors is acceptable.

Secondhand Nicotine

Nicotine in exhaled e-cigarette vapor is determined in a manner similar to traditional cigarette smoke. Though the levels are low (most nicotine is absorbed into the bloodstream by

the user), there is still concern that with repeated exposure, nicotine in secondhand vapor can have an effect on people other than the user – especially children. Young children and infants with developing brains are at increased risk of having nicotine-related neural complications.

According to a study reviewed by the NIH on adolescent exposure to nicotine in rodents:

“Nicotinic acetylcholine receptors (nAChRs) regulate critical aspects of brain maturation during the prenatal, early postnatal, and adolescent periods...

We present evidence that nicotine influences limbic system and late monoamine maturation during adolescence. Chronic nicotine in adolescence has been shown to cause greater and longer-lasting alterations in cholinergic signaling than in adults. Exposure to nicotine during adolescence may preferentially interfere with limbic circuitry, producing enhanced vulnerability to nicotine addiction, increased impulsivity, and mood disorders”.

(Dwyer, McQuown, & Leslie, 2009)

Due to an increased risk of developing complications, parents are advised to avoid exposing their children to these secondhand vapors.

Thirdhand Exposure

Another reason parents who use e-cigarettes should stay outdoors when vaping, is the risk of third hand exposure. According to an article on Nosmoke.org, studies have concluded that, “There is a risk of thirdhand exposure to nicotine released from ESD aerosol that deposits on indoor surfaces,” (Americans for Nonsmokers’ Rights, 2015). In addition to nicotine, potentially harmful VOCs and nanoparticles are also deposited on surfaces. As a result of studies demonstrating these risks associated with third hand exposure, public health officials and organizations such as the WHO have strongly recommended that e-cigarettes not be used inside

until long-term studies have been concluded. Furthermore, parents who use e-cigarettes should avoid vaping inside their homes even when children are not present to avoid the risk of passive intake of these chemicals.

Pregnant Women

Pregnant and breastfeeding women should not be exposed to ESD vapor on any level, including secondhand and thirdhand exposure. Nicotine exposure studies have proven to cause babies to develop feeding problems, as well as delayed physical and mental development. These problems can then lead to other future issues as children grow, such as memory loss, impaired senses, and ADHD (Dwyer, McQuown, & Leslie, 2015). This same article published by the NIH also states, “Prenatal nicotine exposure produces autonomic deficits, which may underlie the increased incidence of SIDS... Children of mothers who smoked exhibit increased incidence of ADHD and substance abuse during childhood and adolescence”. Due to the degenerative problems resulting from nicotine in tobacco smoke, it can be conjectured that nicotine in e-cigarette vapor can cause similar effects, and should be avoided entirely by pregnant and breastfeeding mothers.

Behavioral Influence

Kids can be a positive reinforcing factor for parents trying to quit smoking. However, switching to e-cigarettes should not be treated as truly quitting. It has been argued that parents who smoke e-cigarettes can influence the behavior and decisions of their children in terms of their smoking habits. According to Karl Hill, a director of the Seattle Social Development Project at the University of Washington, “Twelve-year-olds whose parents smoked were more than two times as likely to begin smoking cigarettes on a daily basis between the ages of 13 and 21 than were children whose parents didn’t use tobacco,” (Schwarz, 2005). He goes on to

conclude that, “The evidence is clear from this study that if parents don’t want their children to start smoking, it is important for them to stop or reduce their own smoking.”. Similarly, a study at Purdue University also found that:

The children of later-life smokers were 29 percent more likely to smoke...

Based on these findings, antismoking prevention for youth really needs to target the children of parents who smoked. Even in an era of declining rates of teenage cigarette use in the United States, children of current and former smokers face an elevated risk of smoking.

(Vuolo, 2013)

If there is an elevated risk associated with parental behavior regarding traditional smoking, the same risk can be applied to those using ESDs. Telling children to quit traditional cigarettes but encouraging them to move on to e-cigarettes enforces that e-cigarettes are safe and acceptable ways to get nicotine. Parents should avoid using them in front of their children regularly, to prevent children from viewing vaping as normative behavior.

Conclusion

Are E-cigarettes Harmful to Human Health?

The FDA’s position on the effects of e-cigarettes is there is “not currently have sufficient data about these products to determine what effects e-cigarettes have on the public’s health.” (Parmet, 2015).

Inhaling any type of substance other than Earth’s natural air mixture (oxygen, carbon dioxide, and nitrogen) is not a healthy decision. Simply, our bodies are not evolutionarily adapted to inhale any other mixture of chemicals. Vaping is not entirely healthy and comes with its own set of health risks that should be understood.

Studies have been conducted under many different conditions to test the toxicity of e-cigarette vapor. Though most do find that they contain far lower levels of harmful chemicals when compared to regular tobacco smoke – their findings cannot be ignored. Health effects from e-cigarettes should be a largely studied issue over the course of time to determine what can happen and how it can be dealt with medically or prevented. As of now, concerns of scientists, health professionals, and lawmakers alike are about safety, health outcomes, addictive capabilities, and effects on non smokers.

E-cigarettes and ESDs have not been proven to be safe. Though most experts would agree that they have the potential to be less-harmful than traditional cigarettes, there are still risks involved with using these devices. Many are lured into trying e-cigarettes because of the similar sensation to smoking. However, people should be aware of their potential risks and addictive capabilities. Parents should be especially aware and should educate their kids about risks associated to prevent their children from experiencing economic and social consequences associated with vaping. E-cigarette usage should adhere to the precautionary principle and should not be labeled as a safe alternative to smoking until more studies are concluded.

References

- Agency for Toxic Substances and Disease Registry. (2011, March 3). *Propylene Glycol*. Retrieved from <http://www.atsdr.cdc.gov>.
- Al Jasser et al. (2011, May 16). *Propylene glycol: an often unrecognized cause of allergic contact dermatitis in patients using topical corticosteroids*. Retrieved from <http://www.ncbi.nlm.nih.gov>.
- Americans for Nonsmokers' Rights. (2015). *Electronic Smoking Devices and Secondhand Aerosol*. Retrieved from <http://no-smoke.org>.
- Blu™ E-cigarette Company. (n.d.). Retrieved June 7, 2015, from Blucigs.com.
- Briant, Thomas A. (2015, May 6). *E-Cigarette Tax Bill Update*. Retrieved from <http://www.cspnet.com>.
- CanadaVapes.com. (2015). *Vegetable Glycerin Safety*. Retrieved from <https://canadavapes.com>.
- CDC. (n.d.). *Current Cigarette Smoking Among Adults in the United States*. Retrieved on July 17, 2015, from <http://www.cdc.gov>.
- CDC. (2014, April 3). *New CDC Study Finds Dramatic Increase in E-cigarette-related Calls to Poison Centers*. Retrieved from <http://www.cdc.gov>.
- Chakraborty, Barnini. (2014, March 18). *States Push to Regulate, Tax Booming E-cigarette Industry*. Retrieved from <http://www.foxnews.com>.
- Cheng, Tianrong. (2014, February 28). *Chemical Evaluation of Electronic Cigarettes*. Retrieved from <http://tobaccocontrol.bmj.com>
- Cressey, Daniel. (2014, March 24). *Electronic Cigarettes 'Don't Aid Quitting', Study Says*. Retrieved from <http://www.nature.com>.
- Dwyer, McQuown, & Leslie. (2009, March 5). *The Dynamic Effects of Nicotine on the Developing Brain*. Retrieved from <http://www.ncbi.nlm.nih.gov>.
- Eversmoke™. (n.d.). *Problems While Vaping: Is it an Allergic Reaction or a Cessation Symptom?*. Retrieved from <http://www.learn.eversmoke.com>.
- Eversmoke™. (n.d.). *Taxing Smokeless Cigarettes*. Retrieved on July 14th, 2015 from <http://www.learn.eversmoke.com>.
- Farsalinos et al. (2013, October 16). *Comparison of the Cytotoxic Potential of Cigarette Smoke and Electronic Cigarette Vapour Extract on Cultured Myocardial Cells*. Retrieved from

<http://www.mdpi.com>.

FEMA.gov. (2014, October). *Electronic Cigarette Fires and Explosions*. Retrieved from <https://www.usfa.fema.gov>.

Gleason, Patrick. (2015, January 29). *Electronic Cigarettes Remain Top Tax Targets for Politicians*. Retrieved from <http://www.forbes.com>.

Gromisch, Maryann. (2013, October 24). *The Effects of Nicotine on the Cardiovascular System*. Retrieved from <http://www.livestrong.com>.

Healy, Michelle. (2014, June 2). *An 'Explosion' of Youth Exposure to E-cigarette TV Ads*. Retrieved from <http://www.usatoday.com>.

King, Patel, Nguyen, Dube. (2014, September). *Trends in Awareness and Use of Electronic Cigarettes Among U.S. Adults, 2010-2013*. Retrieved from <http://www.cdc.gov>.

Koch, Wendy. (2012, September 17). *E-cigarettes: No smoke, but Fiery Debate Over Safety*. Retrieved from <http://usatoday30.usatoday.com>.

Mascarelli, Amanda L. (2014, March 19). *The Dangerous Rise of Electronic Cigarettes*. Retrieved from <https://student.societyforscience.org>.

McAuley, Hopke, Zhao, Babaian. (2012, October 24). *Comparison of the Effects of E-cigarette Vapor and Cigarette Smoke on Indoor Air Quality*. Retrieved from <http://www.ncbi.nlm.nih.gov>.

Mohney, Gillian. (2014, December 12). *First Child's Death From Liquid Nicotine Reported as 'Vaping' Gains Popularity*. Retrieved from <http://abcnews.go.com>.

Opar, Alisa. (2013, May 7). *Do Electronic Cigarettes Really Help Smokers Quit?*. Retrieved from <http://www.scientificamerican.com>.

Parmet, Wendy. (2015, February 20). *In Regulating E-Cigarettes, No Easy Fix for the FDA*. Retrieved from <http://healthaffairs.org>.

Prabhat Jha et al. (2006). *Chapter 46 - Tobacco Addiction: Disease Control Priorities in Developing Countries. 2nd Edition*. Retrieved from <http://www.ncbi.nlm.nih.gov>.

Raloff, Janet. (2014, June 3). *Health Risks of E-cigarettes Emerge*. Retrieved from <https://www.sciencenews.org>.

Rimer, Sara. (2015). *Behind the Vapor*. Retrieved from <http://www.bu.edu>.

Ritchel, Matt. (2014, March 23). *Selling a Poison by the Barrel: Liquid Nicotine for E-cigarettes*. Retrieved from <http://www.nytimes.com>.

Schwarz, Joel. (2005, September 28). *Children Whose Parents Smoked are Twice as Likely to Begin Smoking Between Ages 13 and 21 as Offspring of Nonsmokers*. Retrieved from <http://www.washington.edu>.

Sifferlin, Alexandra. (2014, March 24). *Study: E-cigarettes do not Help People Quit Smoking*. Retrieved from <http://time.com>.

Thompson, Derek. (2012, September 20). *Low-Income Smokers in New York Spend 25% of Their Income on Cigarettes*. Retrieved from <http://www.theatlantic.com>.

U.S. National Library of Medicine. (2013, January 30). *Nicotine Poisoning*. Retrieved from <http://www.nlm.nih.gov>.

University of California, San Francisco. (n.d.). *9 Chemicals Identified so far in E-cig Vapor that are on the California Prop 65 List of Carcinogens and Reproductive Toxins*. Retrieved on July 15th, 2015, from <http://www.tobacco.ucsf.edu>.

USA Today Editorial Board. (2015, May 5). *Butter Crunch E-cigarettes? Who Are You Really Targeting? Our View*. Retrieved from <http://www.usatoday.com>.

Vinik, Danny. (2014, April 24). *E-Cigarettes vs. Tobacco Cigarettes Cost Comparison: Which is Cheaper*. Retrieved from <http://www.newrepublic.com>.

Vuolo, Mike. (2013, August 5). *Study: Teens' Smoking Influenced by Older Siblings, Parents' Lifelong Smoking Habits*. Retrieved from <http://www.purdue.edu>.

Wagner, David. (2014, March 28). *E-Cigarette Overdose: How Much Liquid Nicotine Would It Take To Kill You?*. Retrieved from <http://www.kpbs.org>.