E-CIGARETTES IN
The Impact on Company

By Blake Barton, Kristen Spicer and Traci Byrd

IT HAS BEEN MORE THAN A DECADE since electronic nicotine delivery systems (ENDS), more commonly known as e-cigarettes, were introduced to the U.S. E-cigarettes are personal handheld vaporizers that produce an aerosolized mixture containing specialized e-liquids, nicotine and other solvents that are inhaled by the user (AAP Section on Tobacco Control, 2015). First marketed as a healthier alternative to traditional tobacco use, these products were thought to potentially decrease conventional tobacco cigarette smoking and reduce toxic exposures from secondhand smoke. With several different types, brands and components, e-cigarettes can be modified to suit the consumer's preferences.

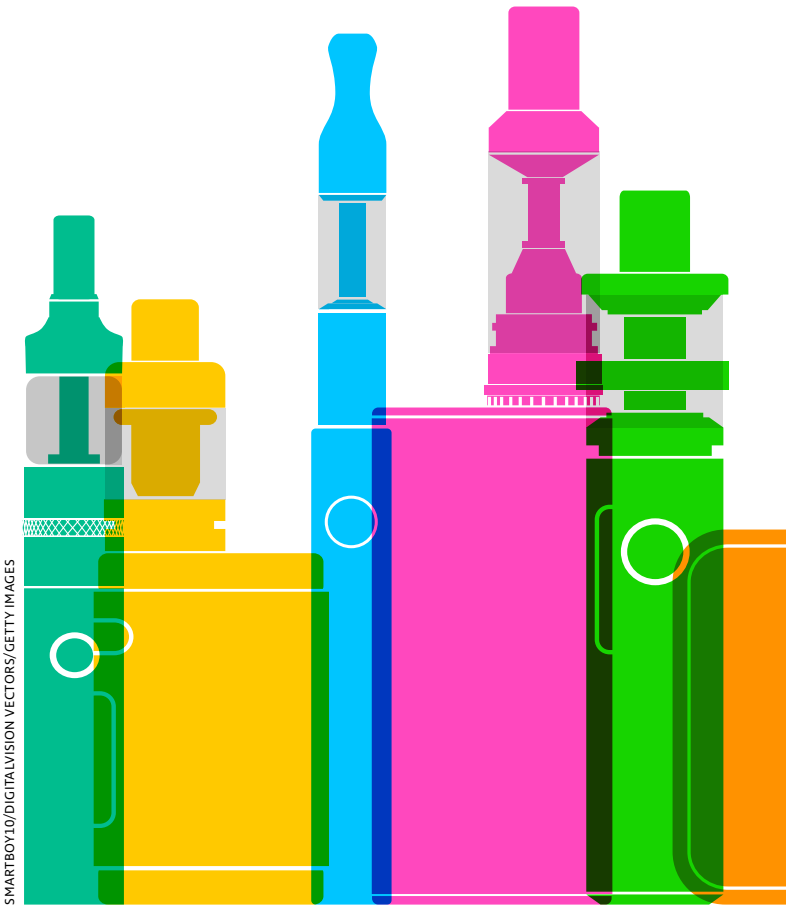
E-cigarette popularity has steadily increased. In 2017, CDC reported that 2.8% of U.S. adults, or roughly 9 million, were current e-cigarette users. Today, the U.S. Food and Drug Administration (FDA) has declared the use of e-cigarettes among the adolescent population to have reached epidemic proportions. Use among this population has risen from 1.5% in 2011 to 11.7% in 2017 (Wang et al., 2018). The potential adverse health effects of human usage of e-cigarettes and secondhand exposure to the substances given off and inhaled have yet to be identified. Due to the limited number of toxicological and chemical studies investigating potential adverse health effects of e-cigarettes, many questions have been raised regarding the surge in the use of e-cigarettes as to whether such products should be allowed in the workplace. Concerns have been raised about indoor air quality as well as potential risks to human health via exposure.

While employers worked to comply with promulgated smoking bans, a report found that by 2007, 91% of U.S. employees were working under smoking restriction policies (AllOne Health Resources, n.d.). However, many of these policies did not include and continue to neglect the issue of e-cigarette use while at work. American Nonsmokers' Rights Foundation (ANRF, 2019) reports that 81.8% of the U.S. population live under a legislated smoking ban covering all workplaces and restaurants. CDC (2019b) reports approximately 20% of U.S. workers are still exposed to secondhand smoke on the job.

It is legally within employers' purview to regulate the use of e-cigarettes on their premises through smoking restriction policies as part of company drug and alcohol programs. Employers that do not currently include e-cigarettes in company drug and alcohol policies must consider the reported rapid increase in usage. As increasingly more e-cigarette users will join the workforce in the coming years, the increased risk exposure along with associated physical hazards, even in the absence of new regulations, will strongly encourage, if not force, employers to include e-cigarette usage in company drug and alcohol policies.

KEY TAKEAWAYS

- **While cigarette smoking has declined in the U.S., e-cigarette use is soaring. Many company drug and alcohol policies include standalone smoke-free workplace policies, which often define the act of smoking and what can be smoked, but typically do not address e-cigarette use.**
- **Employers must address both the use and presence of e-cigarettes in the workplace. The devices and their components present similar hazards to traditional cigarettes with additional potential to pose even greater harm to people and property, as evidenced by incidents of battery failure, explosions and fires.**
- **This article discusses the potential impact of e-cigarettes in the workplace as well as the impact on current company drug and alcohol policies within the context of current information regarding e-cigarette usage.**



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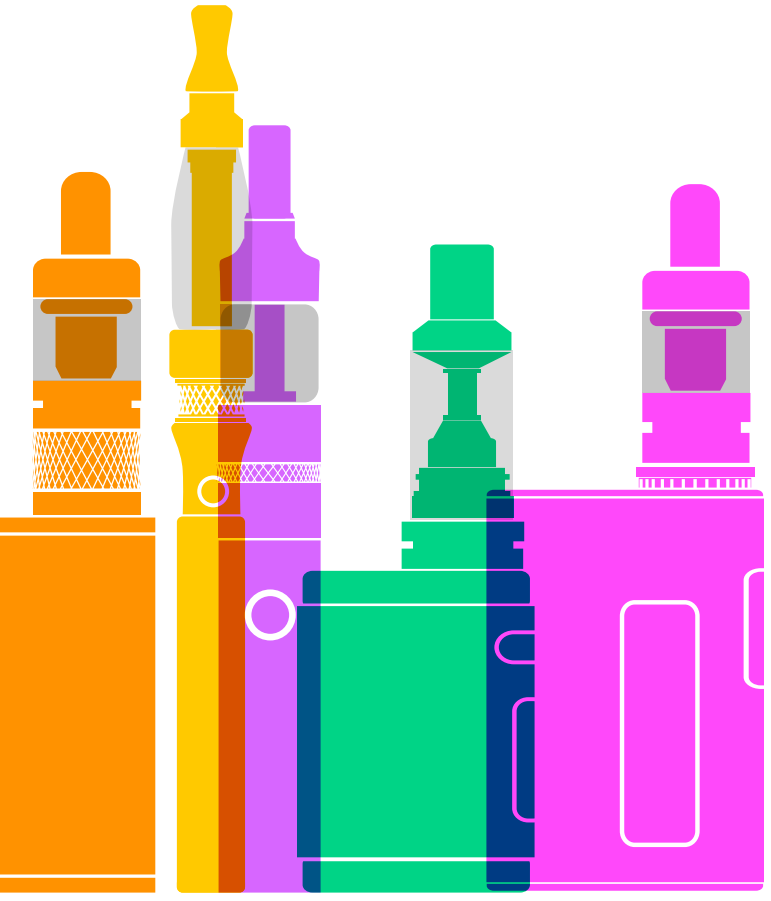
THE WORKPLACE
Alcohol & Drug Policies

The detrimental impact of secondhand smoke from traditional cigarettes has been well documented and upheld. However, little is known today about the hazards of secondhand e-cigarette emissions. Many documented incidents have shown the devices themselves to have significant accompanying dangers. The discussion that follows focuses on the OSH issue of e-cigarettes impact on both the workplace and company drug and alcohol policy. Throughout this article, unless otherwise specified, the term "e-cigarette" is used to reference all types and brands of ENDS.

History of Smoking & E-Cigarettes

Smoking has been performed throughout history for spiritual, religious, traditional, psychological, mental, physical and recreational purposes. Tobacco, a commonly smoked substance, is prepared by curing the leaves of a tobacco plant.



Nicotine, the main active ingredient of concern with tobacco, acts as both a sedative and stimulant. Nicotine exposure causes the release of dopamine within the pleasure and motivation centers of the brain, causing the user to experience a pleasurable sensation similar to the effect of using heroin or cocaine (Felman, 2018).

According to Marcham and Springston (2017), "E-cigarettes were originally designed in 1963 by Herbert Gilbert and patented in 1965 as a smokeless, nontobacco cigarette intended to provide a harmless means of smoking (U.S. Patent No. 3,200,819 A, 1965)." This means of purportedly harmless smoking was marketed as a way for traditional tobacco cigarette users to wean themselves from the toxic products while providing a healthier alternative that still allowed for pleasurable experiences. Since its beginning, e-cigarette manufacturing has greatly increased with estimated annual sales, in the present-day U.S., of more than $2 billion (Marcham & Springston, 2017). Sales are expected to increase as popularity of e-cigarettes, especially among teens and adolescents, has risen and continues to rise.

Types of E-Cigarettes

E-cigarettes come in various options with modifiable components. E-cigarettes are the most common form, resembling conventional tobacco cigarettes in both shape and size; however, products such as e-cigars, e-hookahs, e-pipes and "mods" (modified e-cigarettes) exist as alternative options. Disposable and rechargeable e-cigarette options also exist. Disposable e-cigarettes are self-explanatory: once the battery cartridge inside them is depleted, they are no longer usable and are meant for disposal. When the battery cartridge in a rechargeable e-cigarette runs out, it is to be plugged into an electrical source to recharge for additional usage.

E-cigarette components such as battery output voltage and e-liquid flavors can be modified to meet the wants of the user. Leigh et al. (2016) performed a comparison study that focused on popular e-liquid flavorings and their effect on inhalation toxicity regarding the aerosols generated from e-cigarettes. Results showed traditional tobacco cigarettes provided more risk in that they have greater adverse effects on healthy cells, specifically the bronchial epithelial cells of the lungs while also negatively impacting cell viability and metabolic activity when compared to the different ENDS devices that were tested. Different flavors of e-liquids were also tested. Results showed a significant increase in toxicity in the ENDS aerosols.

The same study also found that increasing battery output voltages significantly decreased metabolic activity and cell viability, which leads to the conclusion that increasing battery output voltages further increase the risk of using ENDS

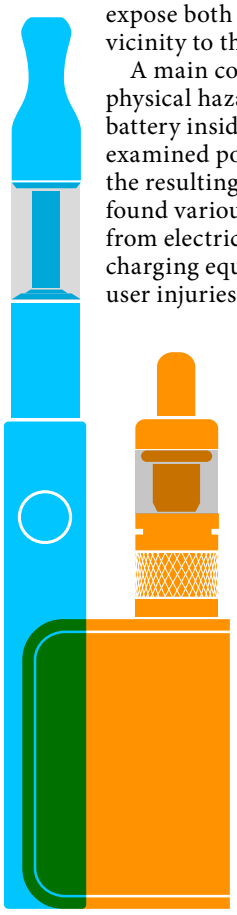
devices (Leigh et al., 2016). A decrease in cellular metabolic activity and cell viability has the potential to make the body susceptible to opportunistic illnesses and diseases by lessening the body's ability to protect and heal itself and respond to environmental changes.

Functionality

E-cigarettes are devices that allow for vapors and aerosols to be inhaled (known as "vaping"). The process is simple: inhaling or pressing an activation button activates the lithium ion battery to charge the atomizer, which heats up a liquid solution that is stored inside of a cartridge or reservoir module. The heat causes the e-liquid to vaporize inside the cartridge, which produces an inhalable vapor (AIHA, 2014). The inhaled vapor is meant to mimic the feeling of smoking a traditional tobacco cigarette without consuming the associated adverse toxic substances in traditional tobacco cigarettes such as tar, formaldehyde and ammonia.

Health & Physical Hazards Associated With E-Cigarettes

Many users believe the e-cigarette to be a safer alternative to smoking traditional tobacco cigarettes. However, there are a number of misconceptions and a true lag in the understanding of the known hazards associated with e-cigarette usage. Marcham and Springston (2017) concede that there are fewer reported health risks related to using e-cigarettes when compared to smoking traditional cigarettes. However, the researchers take aim at the misperception that e-cigarettes produce only water vapor, stating, "These devices release nicotine and other chemicals in a vapor form that can expose both the user and those in the immediate vicinity to the contaminants" (p. 47).



A main component of concern regarding the physical hazards of e-cigarettes is the lithium ion battery inside these products. Pepper et al. (2018) examined potential e-cigarette battery failures and the resulting harm posed to users. Pepper's team found various causes for battery failure, ranging from electrical and mechanical reasons to misuse of charging equipment. Resulting hazards range from user injuries to explosions. What follows is a discussion as to the current known health and physical hazards associated with e-cigarettes.

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Health Hazards: Glycerin (Glycerol), Propylene Glycol & Diacetyl

While several ingredients make up e-liquids, the major ingredients of most e-liquids on the market are vegetable glycerin (glycerol) or propylene glycol. Glycerol is a viscous liquid formed as a byproduct in soap manufacturing. The main uses of this substance are as an emollient and laxative, and for making explosives and antifreeze. Generally recognized as safe for use in food by FDA, propylene glycol is a synthetic liquid substance that absorbs water (ATSDR, 2011).

While e-cigarettes contain these substances, varying ranges of propylene glycol and glycerin concentrations present in e-liquids can alter risks associated with exposure to these ingredients. Marcham and Springston (2017) summarized the research efforts of various investigators whose studies have shown that when glycerol is heated within the coil of an e-cigarette, it is possible for recognized human carcinogens such as formaldehyde and other organic compounds to be produced within the vapor. Jensen et al. (2015, as cited in Marcham & Springston, 2017) have raised concerns regarding higher airborne concentrations of formaldehyde being detected in e-cigarettes that operate at an increased battery output voltage allowing for "thicker" vapor to be generated.

Studies have also revealed the presence of tobacco-specific nitrosamines (TSNAs) found in the aerosols generated from e-cigarettes. Potent carcinogenic chemicals, TSNAs present the opportunity for hand-to-mouth or thirdhand exposures due to the reaction potential of deposited nicotine and ambient nitrous on touching surfaces (Marcham & Springston, 2017).

With the stark increase of usage among the teenage population and associated lung injuries, researchers are turning their attention to e-cigarette flavorings. Barrington-Trimis et al. (2014) report that more than 7,000 flavorings for e-cigarettes exist. Although there are many chemicals used for flavorings in various products, diacetyl has been found as a predominant chemical used in e-cigarette flavorings. Diacetyl is commonly used to create buttery or creamy flavors in foods. This chemical has been evaluated by the Flavor and Extract Manufacturers Association and deemed safe for ingestion. However, when inhaled it has been found to cause acute-onset bronchiolitis obliterans or "popcorn lung" (Barrington-Trimis et al., 2014). A study conducted by Harvard T.H. Chan School of Public Health (2015) professors revealed that 75% of the e-cigarette flavors and refills tested contained diacetyl (Allen et al., 2016).

Health Hazards: Nicotine

Nicotine is one of the main ingredients found in tobacco used in the manufacturing of traditional cigarettes. The LD50 (median lethal dose) of nicotine is 1.0 mg/kg for adult humans. When exposed to high toxicity levels, users could potentially experience adverse symptoms such as increased respiratory rate, high blood pressure, seizures, fatigue and even death due to muscle paralysis in the respiratory system.

Although traditional cigarettes have been found to contain upwards of 20 times the lethal dose, Göney (2017) suggests approximately 1 mg of nicotine is absorbed from each traditional cigarette. With e-cigarettes, nicotine concentrations within the e-liquids can be customized. Levels can be set at low, medium or high e-liquid nicotine concentrations depending on the user's preference. According to Göney (2017),

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"the concentration ratio of nicotine in the liquid content of e-cigarette varies between 6 and 36 mg/mL. Each cartridge in an E-cigarette is used for approximately 300 breaths" (p. 4), potentially exposing the user to the nicotine equivalent of three to 18 packs of traditional cigarettes.

A primary concern is the inconsistency with the labeling of nicotine levels in some e-liquids. According to Goniewicz et al. (2013), FDA tested certain brands of e-cigarettes to determine if the labeling information was correct with regard to nicotine level (low, medium and high). Although some cartridge labels were found to provide accurate information, Westenberger (2009) and Hadwiger et al. (2010) (as cited in Goniewicz, 2013) reported cartridges labeled "no nicotine" were found to produce a quantifiable level of nicotine. Note that not all e-cigarette brands and products are created equally and can differ in nicotine vaporization efficacy and consistency.

Czogala et al. (2014), performed one of the first studies to measure the concentration of nicotine levels in e-cigarette emissions. They found airborne concentrations of nicotine in secondhand emissions from e-cigarettes, although the reported average concentrations found are lower than those in secondhand tobacco smoke. Due to a gap in the implementation of heightened quality-control standards, secondhand e-cigarette emissions are a growing concern.

This lack of quality control also presents a particular challenge to toxicological investigations. As noted, researchers have found some e-cigarette labels to be misleading with regard to nicotine concentrations. Further, studies have found a number of other chemicals (e.g., arsenic, nickel, traces of lead) to be present in e-cigarette devices, yet these findings have not been published (Chun et al., 2017).

Health Hazards: Heavy Metals

Limited investigations on e-cigarettes and their aerosols/vapors have revealed concentrations of silicate particles and several toxic metals such as tin, silver, nickel, chromium, cadmium, and lead that are equal to or greater than concentrations found in traditional cigarette smoke. When passing through an e-cigarette device, these metals are disseminated at the size of a nanoparticle, which is a decrease in particle size from traditional cigarette emissions. This decrease in particle size allows these carcinogenic compounds to pass more easily through the body's defense mechanisms making users more susceptible to respiratory diseases and disorders (Göney, 2017).

Physical Hazards

Lithium ion batteries in e-cigarettes are capable of heating to extreme temperatures to vaporize the e-liquid into an inhalable aerosol/vapor. Heat-related injuries have been associated with both use and charging of e-cigarettes. Forrester (2016) discusses a review conducted by Texas Poison Center Network wherein several fires and explosions related to e-cigarettes were reported between 2009 and 2015. Incident harm ranged from property damage due to a charging e-cigarette battery exploding in a table drawer to a user suffering second- to third-degree burns to the leg and groin area when an e-cigarette exploded in the user's pants pocket.

Incidents have been documented of both explosions and fires resulting from rechargeable e-cigarettes. According to Forrester (2016), "In October 2015, a man was hospitalized and placed in a medically induced coma after an electronic cigarette exploded in his face." The U.S. Fire Administration identified 25 separate incidents involving e-cigarettes from a media report search conducted from January 2009 to August 2014. Although no deaths were reported, 10 people were injured, two with severe burns when the device exploded in the user's mouth. At the conclusion of this search, the U.S. Fire Administration reported that 80% of the incidents occurred while the device was being charged (Forrester, 2016). Therefore, it may be inferred that the majority of incidents have the greatest potential to occur while the lithium ion battery inside the e-cigarette is charging.

Toy et al. (as cited in Pepper et al., 2018) reviewed e-cigarette burn-related records from November 2015 to March 2017 at a medical center that houses a burn center serving six counties in southern California. The study:

> . . . found 25 cases of patients who sustained e-cigarette battery-related burns. Twelve of the 25 patients were admitted to the hospital for a median stay of 4.5 days; most (72%) of the battery failure incidents occurred while the device was in a user's pocket. (pp. 605-606)

Many rechargeable e-cigarettes use a USB port to connect a power adapter to a power source. Questions and concerns have been raised regarding the USB port because of the potential for burns and harm to the user. Other rechargeable e-cigarettes provide a manufacturer's power adaptor specifically designed for that particular device; however, e-cigarettes connected to power adaptors that are not provided or approved by the manufacturer may be the leading cause for the number of fires and explosions attributed to e-cigarettes. To minimize the potential for and prevent lithium batteries in e-cigarettes from overheating, it is essential to avoid charging the device past its capable power storage threshold (i.e., overcharging the lithium ion battery) and allowing it to overheat and combust.

Physical hazards associated with e-cigarette lithium ion batteries include not only burns, but also the potential for struck-by injuries. Brownson et al. (2010, cited in Pepper et al., 2018) reviewed records from University of Washington Medical Center, which "reported treating 15 patients for e-cigarette battery explosion-related injuries in a 9-month period (October 2015 to June 2016)" (p. 606). According to Marcham and Springston (2017):

> An unfortunate consequence of the e-cigarette design is that the battery is installed in a device that has its weakest point at the ends of the device; when a battery fails, it can be "propelled across the room like a bullet or small rocket" (U.S. Fire Administration, 2014, p. 5). (p. 49)

As the number of incidents such as fires, explosions, burns and other injuries attributed to e-cigarettes have increased, such events have received media attention and brought to light the issue of e-cigarette battery safety.

Public Perceptions

Polls of current and former smokers found that bans on indoor e-cigarette use are significantly lower than that for tobacco cigarette use (Kolar et al., 2014). The majority of the population is opposed to permitting smoking of tobacco cigarettes and other traditional devices in public places, since the adverse health effects of both smoking and secondhand smoke exposure are common knowledge. Kolar et al. (2014) conducted surveillance studies to gauge the level of support for bans on the indoor use of e-cigarettes. In 2012, Majeed et al. (2015) performed a nationwide survey of U.S. adults. Among the 4,043 respondents, 22.6% believed e-cigarette use should be allowed

in designated "smoke-free" environments, 37.5% believed e-cigarettes should be banned or not allowed, and 39.8% either did not know or had no opinion.

Few inquiries have been made regarding users' experiences and what they value from the consumption and use of these products, even though e-cigarette use has increased over recent years as product design has been refined. Studies indicate that e-cigarette users initiate use for various reasons, most frequently to aid in smoking cessation. E-cigarettes are also frequently used as a substitute for traditional smoking where tobacco cigarettes are banned (Baweja et al., 2016). E-cigarette consumers believe these products are safer, healthier, cheaper and more socially acceptable than traditional tobacco cigarettes.

Based on the belief that e-cigarettes produce only water vapor and are therefore harmless, it has been argued that using e-cigarette products should be allowed anywhere on company property. In the case of traditional tobacco products, it is considered to be well within each employer's purview to decide whether to allow designated smoking areas for employees to consume such products. Many of these smoking areas are located outdoors where ample air circulation is present via the natural environment. Many company drug and alcohol policies prohibit the use of traditional tobacco cigarettes and other forms of tobacco products on company premises and property.

Company drug and alcohol policies are enforced to provide safe and healthy working environments in an effort to reduce workplace incidents, injuries and illnesses, as well as reducing employee absenteeism, low morale and lost productivity. Companies must determine the most appropriate policies regarding the use of e-cigarettes in the workplace despite the lack of data to justify the potential health effects (pros and cons) of e-cigarette product use. While uncertainty abounds regarding the health effects of secondhand e-cigarette vapor, a fundamental ethical argument for the ban of e-cigarettes in the workplace is simply as follows: exposure to e-cigarettes should not be imposed upon those who do not choose to use them (Franck et al., 2016).

In 2015, Unger et al. (2016) collected and analyzed tweets from the social media platform Twitter. The investigators sought insight into the public perception of the exposure to secondhand e-cigarette vapors. Tweets were collected over a 6-week period using varying combinations of the following search terms: "secondhand vape" or "vaping," "vape smoke" or "e-cigarette smoke." Tweets were categorized by sentiment (pro, anti, neutral/unknown) and topic (health, social, advertisement, unknown). A total of 3,557 tweets met the required search terms, however, only 1,519 original tweets were analyzed as researchers considered retweets to be duplicate information. Results showed 34% to be pro-e-cigarette tweets, 25% anti-e-cigarette tweets, and 39% to be neutral tweets. Social-focused tweets were found to outnumber the other topic areas and were largely pro-e-cigarette in nature.

The majority of the pro-e-cigarette tweets were in support of people performing smoke tricks with the exhaled vapors/aerosols. They also supported and emphasized the health benefits and freedom involved with using e-cigarettes. Examples of pro-e-cigarette tweets include "Nicotine isn't toxic in the kinds of doses you vape/smoke" and "secondhand vape poses no health risk to bystanders" (Unger et al., 2016, p. 149). The majority of the anti-e-cigarette tweets were aimed toward e-cigarette smokers focusing on the annoyance of being around e-cigarette aerosols/vapors. Examples of anti-e-cigarette tweets include "Ecig smoke makes my head hurt" and "is it possible to second hand vape bc I think its happening and I think I'm going to pass out lol" (Unger et al., 2016, p. 150). While there is no clear consensus regarding the support for e-cigarettes, the devices continue to be a controversial topic among individuals who both use and are exposed to them, willingly or unwillingly.

"It's Just Water Vapor, So It's Not Dangerous"

When first introduced to the market, e-cigarettes were presented to the public as a safer alternative to smoking traditional tobacco cigarettes because the vapor being inhaled was "just water vapor." Industry leaders such as Philip Morris International, Mig Vapor LLC, Reynolds American Inc. and Vapor Hub all share a common advertising platform. All outline the dangers of smoking traditional tobacco cigarettes: the addictive nature of nicotine, the harmful effects of inhaling a concoction of more than 7,000 toxic chemical compounds and, of course, the known killer carcinogens. Manufacturers have claimed several benefits associated with e-cigarettes including:

- provide greater nicotine-level control
- lack of bothersome odor
- cheaper
- can be used "everywhere"

Despite these assurances, many manufacturers encourage users to check local laws regarding e-cigarette use in public places but maintain that their products are considered both environmentally friendly and widely socially accepted.

It has been presumed that e-cigarette companies utilize the "safer alternative" notion as a marketing tool to target current traditional tobacco smokers and encourage them to make the switch to the purported healthier alternative. While there is some evidence showing e-cigarettes are a safer option over traditional tobacco cigarettes regarding associated health and toxicological hazards, they are still not considered completely harmless and do not produce "only water vapor" in the aerosols/vapors.

Currently, CDC (2019a) along with other federal, state and local health officials are conducting investigations into the recent "outbreaks" of lung injuries and deaths associated with the use of e-cigarettes. Investigative efforts have identified vitamin E acetate as the "chemical of concern" thought to be responsible for the reported 2,291 hospitalizations and 48 deaths linked to the use of e-cigarettes.

E-Cigarette Regulation

In 2007, e-cigarettes were introduced to the mainstream U.S. market as smoking cessation tools. In 2008, this marketing strategy prompted an initial regulatory effort by FDA to regulate e-cigarettes as unapproved drug and device combination products (Goldman, 2014). In June 2009, the Family Smoking Prevention and Tobacco Control Act was passed, giving FDA authority to regulate the manufacture, distribution and marketing of tobacco products. This regulatory action included cigarettes, cigarette tobacco, roll-your-own tobacco and smokeless tobacco products but did not specifically include e-cigarettes. In early 2014, FDA proposed a new rule that would not only provide the agency with regulatory authority over e-cigarettes but, along with other constraints, would also ban the sale to individuals under the age of 18 (Goldman, 2014).

The need for the 2014 rule is largely due to the substantial increase in the popularity and use of e-cigarettes, especially among school-age and teenage populations. Prior to the proposal of this rule, the manufacture, ingredients, potential dangers and sale of

e-cigarettes were held to no regulatory statute at either the state or federal level. Tobacco-related laws were considered not applicable to e-cigarettes as the e-liquid nicotine used is not extracted from the tobacco plant used in traditional cigarettes (Barraza et al., 2017). This presented a regulatory gap of protection for all users who began or continued the use of e-cigarettes.

On May 5, 2016, FDA issued a final rule placing e-cigarettes within the scope of the 2009 Family Smoking Prevention and Tobacco Control Act. States and localities retained authority to further restrict sale and use of e-cigarettes (Barraza et al., 2017). The final rule took effect Aug. 8, 2016, and extended regulatory authority over the different business aspects of e-cigarette operations, which include manufacture, distribution and marketing of e-cigarettes. The final rule also mandates that tobacco companies, including those that manufacture e-cigarettes, make known any findings that support that their products are incapable of posing new health risks beyond what previously has been presented via traditional tobacco cigarettes. The primary objective of this rule was to prevent the sale of such e-cigarette devices to adolescents and teens, both high at-risk age groups for use of e-cigarettes (Barraza et al., 2017). As FDA is legally allowed to regulate e-cigarettes:

> states and localities retain authority to raise taxes on tobacco products, including e-cigarettes; implement smoke-free policies; establish minimum prices; raise the minimum legal sales age to 21 years; limit the sale of tobacco to certain retailers or their location or density; or prohibit a class of tobacco products (Feldman, 2014). (Barraza et al., 2017, pp. 3011-3012)

Uncertainty remains as to the impact that e-cigarettes may have on public health; however, discussions, development and implementation of regulations, governance, and laws managing e-cigarettes continue.

AIHA and World Health Organization (WHO) are among the organizations involved and up to date with the current regulatory status of e-cigarettes and have made meaningful recommendations based on the available research.

According to AIHA (2014), e-cigarettes are not emission-free and could pose health risks to both users and to those who are exposed secondhand. Specifically, e-cigarettes are a source of volatile organic compounds (VOCs) and particulates in the indoor environment. These emissions have not been thoroughly characterized or evaluated for safety. As such, e-cigarette use in the indoor environment should be banned until research demonstrates that the inhalation of secondhand e-cigarette emissions will not significantly increase the risk of adverse health effects to bystanders (AIHA, 2014).

A WHO (2014) report states:

> Since the reasonable expectation of bystanders is not a diminished risk in comparison to exposure to secondhand smoke but no risk increase from any product in the air they breathe, ENDS users should be legally requested not to use ENDS indoors, especially where smoking is banned until exhaled vapor is proven to be not harmful to bystanders and reasonable evidence exists that smoke-free policy enforcement is not undermined. (p. 11)

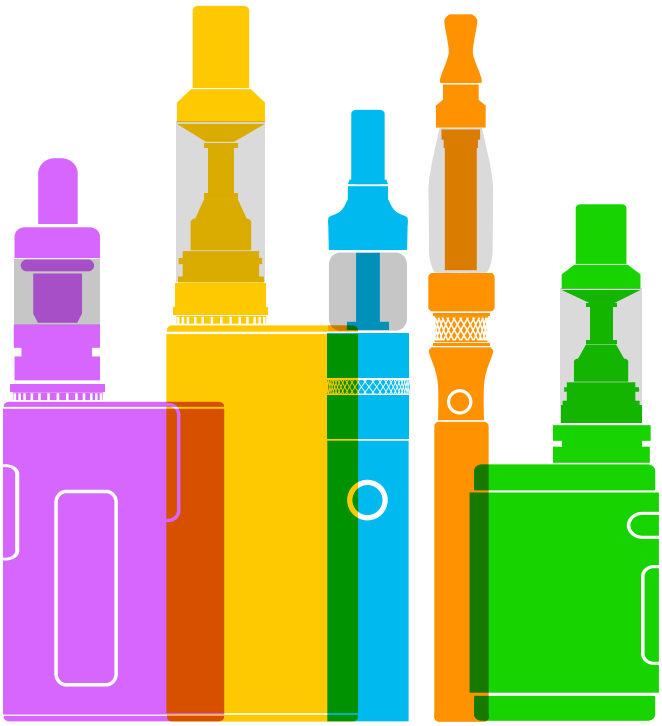
Inclusion of e-cigarettes into smoke-free policies would eliminate confusion regarding e-cigarettes and thereby aid employers in enforcing company policies or policies required by law.

Business Aspects

In 1995, California was the first state to take positive action toward improving public health by requiring all workplaces, bars and restaurants to be smoke free (Hyland et al., 2012), but prior to 1998, few smoke-free policies existed in the U.S. or the world. Researchers estimate that each employee who smokes costs an employer an average of $5,816 annually above the cost of a person who never smoked. This cost considers increased absenteeism, lowered productivity, smoke breaks and healthcare costs (Berman et al., 2014). As of 2020, 27 U.S. states and 55 countries have comprehensive smoke-free laws covering workplaces, bars and restaurants (Campaign for Tobacco-Free Kids, 2020). American Cancer Society (2017) and ANRF (n.d.) agree that smoke-free workplaces are good for both health and business. Smoke-free workplaces are considered safer, healthier and more efficient.

Does It Affect Workplace Safety Culture?

Nicotine is highly addictive and is a teratogen. It can also potentially promote the growth and metastasis of tumors (Davis et al., 2009). Nicotine is one of the most difficult substances for those who are addicted to it to stop using. People exposed to nicotine on a regular basis (including smoking e-cigarettes with nicotine infused e-liquids) can suffer from extreme withdrawal



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Companies must determine the most appropriate policies regarding the use of e-cigarettes in the workplace despite the lack of data to justify the potential health effects (pros and cons) of e-cigarette product use.

symptoms that can decrease productivity and negatively affect mood. Such withdrawal symptoms can include headaches, difficulty focusing and paying attention, anxiety, depression, irritability, and a feeling of emptiness. These withdrawal symptoms can inhibit productivity at work and impede or deter performance both directly and indirectly. The need to regularly take "smoke breaks" as a result of physical dependence on nicotine can interrupt coworkers and create potential conflicts. Nonsmokers demand that their right to clean air be respected while also expecting coworkers to carry an equal workload to meet company productivity quotas.

Environmental Concerns

Chang (2014) suggests that e-cigarettes are potentially detrimental to public health through environmental effects as well as through direct human body effects. Environmental impacts will be felt in the areas of air quality and the generation of hazardous waste produced during manufacturing and disposal of e-cigarette components. Trillions of traditional tobacco cigarettes are produced annually. With so many being produced worldwide, excessive waste is created through an accumulation of trillions of nonbiodegradable filters that litter the earth and negatively affect both aquatic and land-based ecosystems.

E-cigarettes are not necessarily better for the environment. E-cigarettes utilize a lithium ion battery to heat the vaping liquid to create the inhaled aerosols. The lithium ion batteries and nicotine found in e-cigarettes are deemed hazardous wastes by EPA (n.d.). On commercial or industrial work sites, recycling of lithium ion batteries is regulated under the Universal Rules of Hazardous Waste regulations (40 CFR Part 273). It is dangerous to put these batteries directly into the trash due to the fire hazard associated with them. If an e-cigarette with an intact battery is discarded at a commercial or industrial work site, it must be stored, labeled and recycled according to universal waste requirements. In the U.S., EPA hazardous waste regulations do not apply to individual citizens or homes; however, some local municipalities have disposal requirements for electronic waste and household hazardous waste that would apply to individuals.

On Feb. 22, 2019, EPA published its final rule titled Management Standards for Hazardous Waste Pharmaceuticals and Amendment to the P075 Listing for Nicotine. Under this final rule, FDA-approved, over-the-counter nicotine replacement therapies (e.g., nicotine patches, gums, lozenges) will no longer be considered hazardous waste when discarded (EPA, 2019). This ruling does not apply to vape liquids containing nicotine. E-cigarettes are considered a hazardous waste when discarded; more specifically the nicotine liquid is an acute hazardous waste (Marcham & Springston, 2017). Whether individuals use e-cigarettes at home, in public or at work, if these products are brought to a work site and are found in a company's waste stream, potential penalties and fines could be issued as a result of noncompliance with Resource Conservation and Recovery Act hazardous waste regulations.

The Future Workforce Is Vaping

The traditional smoking workforce is quickly becoming a thing of the past. Cullen et al. (2018) discuss data from the 2011-2018 National Youth Tobacco Survey wherein e-cigarette use among high school students was reported to have increased from 1.5% in 2011 to 20.8% in 2018, with a 78% increase found between 2017 and 2018. In August 2018, the U.S. reported 20.9 million youth ages 16 to 24 were employed in the U.S. during summer 2018. Soon these high school students and young adults will be joining the workforce at the professional, skilled labor and unskilled levels.

When surveyed, many young adults were not aware or did not believe e-cigarettes to be harmful and will likely continue their use. This belief that e-cigarettes are harmless increases the likelihood that young adults, new to the workforce, will not consider traditional company smoking policy to be applicable unless e-cigarette use is specifically prohibited under said policy.

Many workplaces throughout the U.S. have smoke-free policies in place and have had for some time, whether these policies are mandated by regulation or voluntarily adopted. Most have designated smoking areas on site where smoking is allowed. Few workplaces have gone completely smoke free and even fewer have addressed the use of e-cigarettes at the workplace or while on the work site. Several safety and health organizations including AIHA, NIOSH, American Society of Heating, Refrigerating and Air Conditioning Engineers, and WHO agree and highly recommend all workplace smoke-free policies should address the use of e-cigarettes until vaping emissions are proven to not be harmful to public health (Marcham & Springston, 2017).

Conclusion

The health hazards and associated expenses of traditional cigarettes have long been known. E-cigarettes share many of the same adverse health effects while also presenting explosive potential as a physical hazard. E-cigarettes can cause harm to both employees and damage to property, whether the device is in use, in storage (e.g., locker, pocket) or being charged.

Comprehensive workplace smoke-free policies are necessary to protect the workforce. E-cigarette use has been subject to scrutiny from users and nonusers. Concerns have been generated regarding indoor air quality and exposures of potential risks to human health. The long-term health effects from direct e-cigarette use and secondhand vapor/aerosol exposure are still largely unknown. Moving forward, it will be essential to conduct more research to understand the potential health risks associated with e-cigarettes so that organizations can make fact-based decisions regarding changes to and implementation of drug and alcohol policies and programs. **PSJ**

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