www.sciencedirect.com/journal/journal-of-vascular-nursing

Clinical Column

A review of the e-cigarette debate

Anne M. Foley, MSN, RN, CRNP, CDE

Although 40 million American adults are estimated to be current smokers, the prevalence of tobacco smoking in the United States has fallen to historic lows.[1] In contrast, noncombustible, electronic cigarette (e-cigarette) use has grown rapidly and more youth use these products compared with any other tobacco products.[1] There are a multitude of names for e-cigarettes including e-cigs, e-hookahs, mods, vape pens, vapes, tank systems, electronic nicotine delivery systems, and more.[1] For the purposes of this article, the term e-cigarette will refer to all of these systems. In 2018, youth use of e-cigarettes has become an epidemic with 3.62 million middle and high school students currently using them.[2]

Modern e-cigarettes were patented in 2003 by a Chinese pharmacist and have greatly evolved over time.[1] Early versions had the appearance of conventional cigarettes, whereas some newer products resemble a pen, a small flask, or a USB flash drive. There are now thousands of products on the market that vary by design, use, functionality, and flavoring.[3] In 2016, there were more than 7,000 unique flavors of e-liquids and e-cigarette products available.[3] Most e-cigarettes consist of a rechargeable, battery-operated heating device that heats a liquid substance into an aerosol, which is then inhaled by the user.[1] The liquid substance usually (but not always) contains nicotine which is derived from tobacco.[1]

This article provides a brief overview of the concerns related to e-cigarettes including health impacts, public health concerns, Federal Drug Administration (FDA) regulations, the debate about nicotine harm reduction, and implications for nurses.

HEALTH IMPACTS

With the heterogeneity of e-cigarette products, it is difficult to research and study the health impacts of these products. An e-cigarette Cochrane review issued in 2016 reported no serious adverse events considered related to their use with mouth and throat irritation being the most frequently noted adverse effects.[4] Others state the short- and long-term effects of e-cigarettes are not really known.[1,3] The main ingredient in most e-cigarettes is nicotine and this is known to be a highly addictive substance. Nicotine is a sympathomimetic drug that releases catecholamines, which increases the heart rate and cardiac contractility, constricts blood vessels, increases blood pressure, and more.[3] Base liquids are often comprised of propylene glycol or glycerin which are generally recognized as not harmful for use in food but safe aerosol levels are unknown.[3]

A 2014 chemical analysis of e-cigarette products revealed toxic chemicals and carcinogens in refill solutions, cartridges, aerosols, and aerosol emissions.[1] Substances included fine/ultrafine particles such as tobacco-specific nitrosamines, aldehydes, metals, and volatile organic compounds and flavors.[1] The appealing flavors of e-cigarettes is cited as a primary reason for use among teens yet lung experts raise concerns about lung and airway inflammation when these liquids are heated.[5] Furthermore, they raise the fear of lung cancer from acrolein, an e-cigarette product that is an herbicide and primarily used to kill weeds.

A key debate surrounding adult tobacco use is nicotine harm reduction. Unlike professionals, who advocate for complete nicotine abstinence, some authors report on harm reduction supporters who see the current generation of e-cigarettes as significantly less dangerous and with fewer carcinogens than traditional cigarettes.[1,6] Drope et al (2017) describe a misperception among health practitioners that nicotine is the major cause of cancer and other diseases associated with tobacco use. Although nicotine is not considered harmless, they argue the more serious health risks come from the chemicals that are formed when tobacco is combusted. Tobacco smoke contains some 7,000 chemicals and the lung inhalation of these "tar" particles and toxic gases are what they claim counts for most deaths and diseases attributable to conventional smoking. They maintain e-cigarettes are less damaging because they deliver nicotine to the blood in a slower manner and in lower concentrations than conventional cigarettes. Some of these harm reduction advocates frame complete abstinence strategies as "moralistic" and miss the point of fundamentally changing the forecast of a billion cigarette-caused deaths this century.[6]

As nicotine is toxic to developing fetuses, professionals are in agreement that e-cigarettes and conventional cigarettes are not advised for pregnant women.[1,3,7] Nicotine use in pregnancy

From the Department of Vascular Surgery, Hospital of the University of Pennsylvania, Philadelphia, PA.

Corresponding author: Anne M. Foley, MSN, RN, CRNP, CDE, Department of Vascular Surgery, Hospital of the University of Pennsylvania, 3400 Spruce Street, Silverstein 4th Floor, Philadelphia, PA 19104 (E-mail: anne.foley@pennmedicine.upenn.edu).

1062-0303/$36.00

https://doi.org/10.1016/j.jvn.2019.05.005

contributes to preterm delivery and stillbirth.[1] Moreover, nicotine exposure may also negatively impact the developing brain of adolescents.[1]

PUBLIC HEALTH CONCERNS

There are pertinent public health concerns which relate to e-cigarettes. Not surprisingly, many youths are unknowingly "vaping" nicotine and may become addicted to nicotine products before they understand the risks.[1,2] Some clinicians fear that e-cigarettes will become a gateway drug and nicotine-addicted teenagers will lead to a resurgence of smoking in the decades to come.[8] Compounding this worry is the fact that a Big Tobacco company recently invested in the JUUL brand of e-cigarettes.[8] This brand is popular with teens and contains highly concentrated nicotine salts, which are more similar in taste and sensation than other e-cigarette products.[9] E-cigarette advertisements have also created a renormalization of nicotine products and subsequently threaten to reverse a decades' long public health campaign which denounced tobacco.[6] Indeed, marketing campaigns target e-cigarettes to young persons by offering college scholarships, creating a buzz on social media, and sponsoring music festivals and events.[10] Although current workplace smoking bans are unclear as it relates to e-cigarettes, some cities and states are amending indoor clean air laws to restrict them as well.[6] One study has reportedly shown e-cigarette vapor exposed bystanders to nicotine and not just water vapor as some may claim.[3]

E-cigarettes can also lead to unintended injuries.[3] Small children can be lured by the fruity flavors contained in the many concentrated nicotine products. Liquid nicotine poisoning can occur through ingestion, skin contact, eye contact, or absorption through mucous membranes, and these can be dangerous or deadly depending on the exposure. Unfortunately, there is already a 2014 case report of a child dying from accidental liquid nicotine poisoning. Subsequently, legislation was signed in 2015 mandating child-resistant packaging for all liquid e-containers sold in the United States. Other safety concerns are the rare explosions and fires from e-cigarette devices from improper charging, mishandling of batteries, or other random malfunctions. These have led to minor and severe physical damages including burns, shattered teeth and vertebrae, facial fractures, and concussions.[3]

FDA REGULATIONS

New regulations finalized in 2016 gave the FDA the authority to control e-cigarettes as a tobacco product.[1,2] This includes regulation of manufacturing, importing, packaging, labeling, advertising, promotion, and sales and distribution of e-cigarettes and their components.[2] Retailers must comply with these directives, which include a federal mandate to only allow sale of tobacco products to persons aged 18 years or older and to require age verification by photo ID.[2] Some states have enacted stricter laws with the age limit set at 21 years of age. Since 2018, e-cigarettes must not be sold or distributed without a health warning on the package. Furthermore, the FDA hopes to ban the sale of all flavored e-cigarettes (other than tobacco, mint, and menthol) except at in-person, age-restricted locations.[2] Refer to the FDA's "The Real Cost" campaign, which is a program intended to prevent youth from using e-cigarettes.[2]

E-CIGARETTES AS A TOBACCO CESSATION AID

There is an ongoing debate regarding the potential benefit of e-cigarettes for adult smokers who are not pregnant, if used as a complete replacement for regular cigarettes and other tobacco products. Although Drobe et al (2017) do not make specific clinical recommendations, they provide an in-depth discussion of the key issues surrounding this matter.[1] They suggest current research shows that e-cigarettes are significantly less harmful than combustible tobacco. Some physicians are in full favor of using e-cigarettes as a tobacco cessation aid and report helping thousands of smokers quit conventional cigarettes with methods that include these novel devices.[11] Major U.S. health agencies even disagree on the issue. The Centers for Disease Control and Prevention states e-cigarettes have the potential to benefit adult (nonpregnant) smokers if used as a complete substitute for regular cigarettes.[7] The Lung Association recommends only FDA-approved treatments and counseling to quit conventional cigarettes.[5]

There are a variety of over-the-counter, FDA-approved nicotine replacement therapies (NRTs) including the nicotine patch, gum, and lozenge. Nicotine-based products that require a prescription are the nicotine inhaler and nasal spray; varenicline and bupropion are the 2 non-nicotine–based prescriptions approved by the FDA.[1] There are advantages and disadvantages to each of these therapies and a combination of products is often used. Some researchers have studied the nicotine metabolite ratio, a genetic biomarker of nicotine clearance, which may predict who may have a more favorable response to the nicotine patch or varenicline for smoking cessation.[12] Persons who are using NRT for tobacco cessation often underdose themselves, resulting in a chronic state of low-level nicotine withdrawal.[1] The high cost and lack of convenient access to NRT are often listed as barriers to use for smoking cessation.[3] Undeniably, e-cigarettes may be more attractive to conventional smokers as they are readily accessible (eg, gas stations and convenience stores) and cost half the price when compared with approved NRTs.[3]

A recent, unblinded, randomized study of 866 participants attending smoking cessation clinics was undertaken in the United Kingdom, which compared e-cigarettes to NRT.[13] Both groups reported the alternates to be less satisfying than smoking cigarettes. Researchers found that e-cigarettes were more effective for smoking cessation than NRT when both products were also partnered with behavioral support. Nausea was reported more frequently in the NRT group, and throat or mouth irritation was reported more frequently in the e-cigarette group. E-cigarettes were reported as more effective in alleviating nicotine withdrawal symptoms. The 1-year abstinence rate was 18.0% in the e-cigarette group, as compared with 9.9% in the NRT group. Notably, among participants who sustained abstinence at 1 year, 80% in the e-cigarette group were still using e-cigarettes, whereas only 9% in the NRT group were. These researchers state that continued e-cigarette use may pose unknown health risks. Other clinicians warn against complacency in accepting ongoing e-cigarette use as a completely successful smoking cessation outcome.[14] Others cite preliminary research that shows many conventional smokers who switch to

e-cigarettes in hopes of quitting actually become users of both.[1,3] This practice is known as dual use and generates little to none of the positive health impacts of quitting combustible tobacco products altogether.[1,3,14].

IMPLICATIONS FOR NURSES

The reader is referred to Prochnow's (2017) article, which provides nurses with a practical evidence-based guide on e-cigarettes.[3] She expresses concern that health professionals' knowledge is lacking and is not keeping pace with the fast-growing e-cigarette industry. She relates the nursing opportunity to screen, discuss, and counsel patients regarding nicotine and e-cigarettes using the "5 A's" model. This includes asking, advising, assessing, assisting, and arranging user assistance. For example, nurses can use nonshaming language when acknowledging barriers to tobacco cessation and refer patients to the free, government-supported quit line (online at http://smokefree.gov or call 1–800-Quit-now). In addition, as a complete nicotine cessation proponent, she outlines the "5 R's," which can be used to enhance nicotine users' impetus to quit. These strategies include a motivational cessation discussion in terms of relevance, risk, rewards, roadblocks, and repetition. For instance, nurses may identify fear of failure, depression, withdrawal symptoms, and/or limited financial resources as a patient's roadblock to quitting. Nurses can get involved in additional nicotine cessation activities. This may include engaging human resource leaders to evaluate current tobacco policies. Nurses can also participate in community events which spread the word about the dangers of e-cigarettes.

SUMMARY

In summary, the e-cigarette industry is rapidly expanding and nurses need to familiarize themselves with the issues relating to e-cigarettes including types of products, health risks to youths, adults and developing fetuses, safety concerns, patient counseling strategies, and the debate over adult e-cigarette use as a potential method to quit conventional cigarettes. Today's youth are using e-cigarettes in record numbers, and the long-term effects of these products remain unknown.

REFERENCES

1. Drope J, Cahn Z, Kennedy R, et al. Key issues surrounding the health impacts of electronic nicotine delivery systems (ENDS) and other sources of nicotine. CA Cancer J Clin 2017;67(6):449-71.
2. U.S. Food and Drug Administration. Vaporizers, e-cigarettes, and other electronic nicotine delivery systems (ENDS); 2019. https://www.fda.gov/tobaccoproducts/labeling/productsingredientscomponents/ucm456610.htm. Accessed February 19, 2019.
3. Prochnow JA. E-cigarettes: a practical, evidence-based guide for advanced practice nurses. J Nurse Pract 2017;13(7):449-55.
4. Hartmann-Boyce J, McRobbie H, Bullen C, et al. Electronic cigarettes for smoking cessation. Cochrane Database Syst Rev 2016;9:CD010216.
5. American Lung Association. The impact of e-cigarettes on the lung; 2019. https://www.lung.org/stop-smoking/smoking-facts/impact-of-e-cigarettes-on-lung.html. Accessed February 12, 2019.
6. Fairchild AL, Bayer R, Colgrove J. The renormalization of smoking? E-cigarettes and the tobacco "Endgame" [Perspective]. N Engl J Med 2014;370(4):293-5.
7. Centers for Disease Control and Prevention. About electronic cigarettes (E-Cigarettes); 2018. https://www.cdc.gov/tobacco/basic_information/e-cigarettes/about-e-cigarettes.html. Accessed January 27, 2019.
8. Drazen JM, Morrissey S, Campion EW. The dangerous flavors of E-cigarettes [Editorial]. N Engl J Med 2019;380(7):679-80.
9. Crawford C. AAFP Offers resources as "juuling" increases among youth [AAFP News]. Ann Fam Med 2018;16(5):471-2.
10. Truth Initiative. 4 marketing tactics e-cigarette companies use to target youth; 2019. https://truthinitiative.org/news/4-marketing-tactics-e-cigarette-companies-use-target-youth. Accessed February 19, 2019.
11. Polosa R, Caponnetto P. E-cigarettes and smoking cessation: a critique of a New England Journal Medicine-commissioned case study [Letter to Editor]. Intern and Emerg Med 2017;12(1):129-31.
12. Lerman C, Schnoll R, Hawk L, et al. Use of the nicotine metabolite ratio as a genetically informed biomarker of response to nicotine patch or varenicline for smoking cessation: a randomised, double-blind placebo-controlled trial. Lancet Respir Med 2015;3(2):131-8.
13. Hajek P, Phillips-Waller A, Przulj D, et al. A randomized trial of E-cigarettes versus nicotine-replacement therapy. N Engl J Med 2019;380(7):629-37.
14. Borrelli B, O'Connor GT. E-cigarettes to assist with smoking cessation [Editorial]. N Engl J Med 2019;380(7):678-9.