

Tobacco Control

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NURSING CLINICS OF NORTH AMERICA



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Tobacco Control

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Guest Editor

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Water Pipe Smoking Among the Young: The Rebirth of an Old Tradition
Virginia Hill Rice

This article provides information on the growing threat of water pipe smoking (hookah) around the world and in the United States. Historically an activity of Middle Eastern older adults, the most recent growth in water pipe smoking (WPS) has been among adolescents and young adults. Associated with its use is a growing list of health problems. To date no interventions have been specifically designed for this form of tobacco use and they are sorely needed. Nurses must continue to teach No Tobacco Use in any form and that means no water pipe smoking must be part of every health message.

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Smokeless Tobacco: a Gender Analysis and Nursing Focus
Cameron White, John L. Oliffe, and Joan L. Bottorff

In recent times, rates of consumption of smokeless tobacco have increased significantly amongst specific subgroups of men, particularly young college men. Recent increases in smokeless tobacco consumption have been characterized by a shift from chewing tobacco to moist snuff. In addition to laying out the health risks of moist snuff, this article describes the social and gendered meanings of smokeless tobacco that reinforce its use. Men-centered approaches to raising awareness about the connections between moist snuff and oral cancer and the availability of oral cancer screening are highlighted as 2 key nursing practice considerations.

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E-Cigarettes: Promise or Peril?
Carol A. Riker, Kiyoung Lee, Audrey Darville, and Ellen J. Hahn

Electronic cigarettes (e-cigarettes) use a heating element to vaporize nicotine and other ingredients, simulating the visual, sensory, and behavioral aspects of smoking without the combustion of tobacco. An ever-growing number of companies around the world manufacture a wide variety of e-cigarette brands, despite scant information on the safety of the ingredients for human inhalation. This article provides an overview of the history, production, and marketing of e-cigarettes, the contents of e-cigarettes and vapor, how they are used, public health concerns, and implications for nursing practice, research, and policy development.

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E-Cigarettes: Promise or Peril?

Carol A. Riker, MSN, RN^{a,*}, Kiyoung Lee, ScD, MPH^{b,c},
Audrey Darville, APRN, CTS^{b,d}, Ellen J. Hahn, PhD, RN^a

KEYWORDS

- Tobacco • Policy • Smoking cessation • Smoke-free
- Harm reduction • Addiction

This article provides an overview of the history, production, and marketing of e-cigarettes, the contents of e-cigarettes and vapor, how they are used, public health concerns, and implications for nursing practice, research, and policy development. Current information was gathered by searching the professional literature and monitoring relevant websites and listservs. This article does not provide a comprehensive, systematic review of the pharmacokinetics and pharmacodynamics of e-cigarette use.

MECHANISM OF ACTION

E-cigarettes are battery-operated devices that contain cartridges generally filled with nicotine, flavor and other chemicals.^{1,2} Puffing activates a battery-operated heating element in the atomizer and the solution in the cartridge is vaporized and inhaled (Fig. 1).³ Because e-cigarettes do not burn tobacco, they do not emit smoke. Rather, the user inhales and exhales a vapor, also called a plume, fog, or aerosol.⁴⁻⁶ Most e-cigarettes are designed to look like traditional cigarettes and simulate the visual, sensory, and behavioral aspects of smoking traditional cigarettes.^{7,8} However, some e-cigarettes look like everyday items such as pens and USB memory sticks that may go unnoticed.⁹ E-cigarette cartridges can be refilled using drops of solution sold in bottles, some of which contain more than 500 mg of nicotine, approximately 10

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Fig. 1. E-cigarette components. (Courtesy of University of Kentucky. Copyright © 2011, University of Kentucky.)

times the lethal dose.³ Pauly and colleagues¹⁰ described the stated or implied intent of e-cigarettes as reducing toxins in the mainstream and secondhand smoke and helping smokers quit.

History of the Product, FDA Regulation, Current Marketing, and Profits

E-cigarettes were introduced into European markets in 2006 and American markets in 2007.¹¹ Because of the rapid increase in use and uncertainty about the chemical contents and their safety, the FDA blocked new shipments in 2008 under its authority to regulate drugs, drug delivery devices, or drug/device combinations under the Food, Drug, and Cosmetic Act (FDCA).¹² In July 2009, the FDA released laboratory analyses of a few e-cigarette samples and issued a public warning that e-cigarettes may contain carcinogens and toxic chemicals, as well as nicotine (which is highly addictive). In this warning, the FDA expressed concern about safety and marketing, including marketing to youth over the internet and at mall kiosks.¹ In September 2010, the FDA sent warning letters to five e-cigarette manufacturers¹³ and wrote to the Electronic Cigarette Association inviting firms to work with the agency toward lawful marketing of e-cigarettes in the United States.⁹

In 2009, the FDA blocked import of a shipment from Sottera, an importer and distributor, claiming authority under the FDCA.¹⁴ Sottera, Inc. challenged the authority of the FDA to prevent import of its e-cigarettes, saying they serve the same purpose as cigarettes, and therefore should be regulated under the Tobacco Act.¹⁴ The District Court agreed and an appeal was filed. The US Court of Appeals for the Washington, DC Circuit decided in December 2010 that e-cigarettes can be regulated as "tobacco products" under the Family Smoking Prevention and Tobacco Control Act of 2009 and that they are not drugs/devices unless therapeutic claims are made. In a letter to stakeholders, the FDA announced the court decision and its intent to regulate e-cigarettes as tobacco products and to consider issuing a "guidance" and/or regulation on "therapeutic" claims.¹⁵ As of September 2011, the FDA was in the initial process of drafting a regulation; they will invite public comment and analyze the comments before a final regulation is issued.¹² When this regulation will be implemented or how broad it will be were unknown as of September 2011.

Meanwhile, those who support and manufacture alternative smoking products have become increasingly interested in the potential to enlarge their customer base and increase profits.² At least three major US organizations promote and advocate for e-cigarettes and other alternatives to smoking, including the Electronic Cigarette Association, the Consumer Advocates for Smoke-Free Alternatives Association (CASAA), and Vapers International, Inc.¹¹ In 2010, the National Vapers Club estimated that at least 1 million people in the United States used e-cigarettes and that the number of e-cigarette companies had risen to approximately 300.¹⁶ In January 2009, Ruyan Group, Ltd. reported worldwide revenues of approximately \$54 million and Vapor Corp reported \$7.95 million in US sales.¹¹

Internet marketing has proliferated through Web sites, social networking sites such as Facebook, YouTube promotional videos, advertising on search engines, and

internet forums that host sessions on how to use e-cigarettes.¹¹ Other marketing outlets include mall kiosks, tobacco retail stores, and contracts with gasoline station distributors. Users can become distributors and recruit customers for profit.⁴ In minutes, one can become a salesperson with access to posters, pamphlets, and business cards, and a Web forum exists for sharing online marketing strategies.⁴ Marketing includes high-tech perks, such as a charging outlet that has a USB port so that e-cigarettes can be recharged on a computer. Some e-cigarettes even have global positioning systems that help the user network with other e-cigarette users nearby to promote social use of the product.¹⁷ E-cigarette marketing patterns are similar to tobacco marketing strategies in that they have entered the world of Hollywood, with appearances in popular movies, television talk shows, and even in the gift bags given the nominees at the 2011 Academy Awards.¹⁸

The FDA and other health agencies remain concerned about how e-cigarettes are marketed to the public and the possibility that they may promote nicotine addiction, delay or derail serious quit attempts, and encourage youth tobacco use. Marketing that portrays e-cigarettes as products that can be used where smoking is prohibited has the potential to cause confusion in the implementation and enforcement of smoke-free policies. Use of e-cigarettes continues to model smoking as an adult norm and may increase the risk of nicotine addiction among youth and young adults.¹⁹ Flavored e-cigarettes marketed as "green" and "healthy" may serve as a new starter product for nonusers. Users who look to e-cigarettes as a cessation aid may not achieve success and may become dual users (using e-cigarettes where smoking is prohibited and continuing their use of traditional cigarettes or other tobacco products where allowed). Some suggest that e-cigarettes would only be of public health benefit if they help smokers completely quit smoking traditional cigarettes.⁷

WHAT DO E-CIGARETTES AND THE VAPOR CONTAIN?

Currently more than 300 brands of e-cigarettes are available, although testing has been conducted on only a few brands, primarily by the FDA and Health New Zealand (e-cigarettes and funding were supplied under a contract with Ruyan [Holdings] Ltd Hong Kong, now doing business as Dragonite International Limited). A Greek study mentioned by several authors was not accessible. Research completed by the Korean National Evidence-based Healthcare Collaborating Agency was provided by coauthor Lee.²⁰ Clearly, a dearth of scientific evidence exists on the safety or efficacy of e-cigarettes.

Nicotine

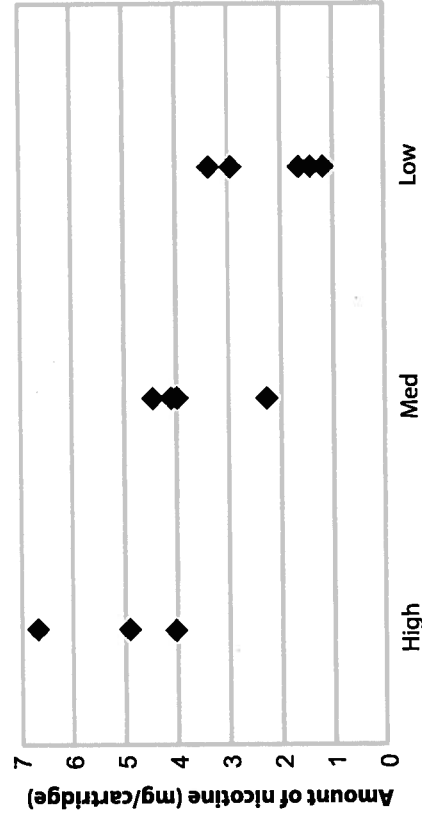
Nicotine is a unique chemical found in tobacco products. Nicotine stimulates mammals at low concentrations and is the main chemical responsible for the dependence-forming properties of tobacco smoking and some of the cardiovascular effects.²¹ It is highly toxic and can be purchased as a pesticide in some parts of the world. Because vapor from e-cigarettes contains nicotine, exposure to the vapor can be harmful to smokers and bystanders. The presence of nicotine in cartridges and vapor from e-cigarettes can be hazardous. Refills may contain high levels of nicotine²² and pose dangers to users and nonusers from leaky cartridges, fluid remaining in spent cartridges, and dermal exposure to nicotine while loading refills.²³ Additionally, nicotine from the vapor or from cartridge fluid sticks to surfaces for weeks or months, reacting over time with nitrous acid in the air to form carcinogens, exposing bystanders via inhalation, ingestion, or dermal exposure.^{19,24}

Nicotine has been found in e-cigarette cartridges, even when the product label does not include nicotine.^{25,26} The FDA's analysis showed that cartridges labeled "high" had the highest nicotine concentration, as shown in Fig. 2.²⁵ However, the nicotine content in similarly labeled cartridges varied. For example, a product labeled "low nicotine" contained more nicotine than one labeled "medium." Additionally, many products labeled as having no nicotine actually contained nicotine; the FDA report detected nicotine in four of five of these cartridges.²⁵ Hadwiger and colleagues²⁸ reported that all five e-cigarette cartridges labeled as containing no nicotine actually contained the drug. Furthermore, products may emit different amounts of nicotine with each puff (26.8–43.2 µg of nicotine per 100-mL puff).²⁵ A nicotine concentration of 0.35 µg per 100-mL puff was measured in cartridges labeled as containing no nicotine.

Propylene Glycol

Propylene glycol, a chemical found in theater "smoke," cosmetics, and foods, is typically used to make the "vapor" emitted from e-cigarettes.² However, a major industrial company recommends that inhalation exposure to mists of propylene glycol be avoided.²⁷ Varughese and colleagues²⁸ studied 101 employees at 19 sites using glycol or mineral oil theatrical fogs, measured personal fog exposure, and found that the fogs have the potential to generate acute and chronic respiratory effects. They also reported reduced lung function with increased proximity to the fog and with cumulative exposure.²⁸ Reduction and elimination of exposure to these theatrical fogs were recommended. The American Chemistry Council (ACC) expressed concern about transient eye pain, conjunctivitis, and tearing from a single contact with theater fog containing propylene glycol.²⁹ The ACC recommended that those exposed to propylene glycol wear eye protection and avoid use of contact lenses.²⁹ The tobacco and pharmaceutical industries have conducted studies on the safety of inhaling aerosolized propylene glycol, but no human studies have been published.^{30,31}

Westenberger²⁵ detected diethylene glycol, an impurity of propylene glycol, in one e-cigarette cartridge. Like propylene glycol, diethylene glycol is colorless and



Nicotine label of cartridge

Fig. 2. Nicotine content of e-cigarettes correlated with levels indicated on label. (Data from Westenberger BJ. Evaluation of e-cigarettes. U.S. Food and Drug Association, 2009. Available at: <http://www.fda.gov/downloads/Drugs/ScienceResearch/UCM173250.pdf>. Accessed August 22, 2011.)

odorless. However, diethylene glycol is highly toxic and has resulted in poisoning epidemics since the early 20th century.³² Because of its adverse effects on humans, diethylene glycol is not allowed in food and drugs.

Other Contents

Very few studies have been conducted on the chemical contents of e-cigarettes and vapor, and these studies tested a limited number of products. Therefore, the chemicals listed in Table 1 do not represent all chemicals contained in e-cigarettes, and concentrations of the chemicals in the cartridges and vapor are not presented. Several other toxic chemicals have been found in e-cigarette cartridges. Hadwiger and colleagues²⁶ reported that some e-cigarettes also deliver drugs for weight loss or erectile dysfunction. One cartridge labeled to contain Cialis did not, but contained amino-tadalafil. Another cartridge containing rimonabant was correctly marked. This chemical may have been added to promote weight control, but it is not approved for use in the United States.

Tobacco-specific nitrosamines, including N-nitrosomonicotine, N-nitrosoanabasine, N-nitrosoanatabine, 4-(methyl/nitrosamino)-1-(3-pyridyl)-1-butanone have been detected in e-cigarette cartridges.^{25,33} Nitrosamines are known carcinogens. Anabasine and myosmine are alkaloids found in tobacco and are chemically similar to nicotine. β-Nicotyrine is an alkaloid derived from the dehydrogenation of nicotine. Anabasine, myosmine, and β-nicotyrine were detected in the cartridges, and β-nicotyrine was measured in the vapor. In addition, several volatile organic compounds were detected in the cartridges, the vapor, or both. Among the volatile compounds, formaldehyde, a known carcinogen, was detected in both the cartridge and the vapor.^{20,33} Considering the potential health effects from the known constituents, the inhaled compounds and the vapor from e-cigarettes are of public health concern.

Currently, no standard method exists to test e-cigarette vapor. The FDA analysis applied a trapping device consisting of a 150-mL gas-washing bottle with a sparger.²⁵ Air was drawn in using a 100-cm³ hand pump. The Health New Zealand experiment applied a disposable plastic syringe connected to the e-cigarette with a short plastic tubing.³³ A smoker's puff was simulated by a moderately rapid pull on the syringe plunger. Because the air drawing speed and puff volume may influence the amount of mist and concentration of solvents, standardization of the experimental method to test the vapor is needed. Extensive testing of cartridges and refills is necessary to standardize the product and test for safety.^{3,7}

HOW ARE E-CIGARETTES USED AND ARE THEY EFFECTIVE FOR SMOKING CESSATION?

At least three online surveys related to e-cigarette use have been conducted. Etter³⁴ surveyed 81 ever-users who mainly used e-cigarettes to quit smoking and found them helpful. However, the sample was self-selected and could have oversampled satisfied, long-term, or heavy users. Participants expressed worry about the potential toxicity of the products. The median duration of use was similar to the median duration of abstinence in former smokers (100 days). Siegel and colleagues³⁵ surveyed 222 respondents in a nonconvenience sample of the first 5000 purchasers from a particular distributor. The authors reported a 31% 6-month smoking abstinence rate. Limitations noted by the authors were that abstinence was self-reported (no biochemical verification), no information was provided on nonresponders (despite a very low participation rate), and users of only one brand were surveyed. Etter and Bullen³⁶ surveyed 3587 participants recruited by an online survey in English and French posted on a smoking cessation Web site. Researchers contacted e-cigarette Web sites and forums

Table 1
Chemicals found in e-cigarette cartridges and vapor

Chemical	Characteristics	Detection Media	Reference (Funding Source)
Amino-tadalafil	Drug analog of the commercially approved Cialis (tadalafil)	Cartridge for e-cigarette labeled to contain Cialis	Hadwiger et al, ²⁶ 2010 (FDA)
Rimonabant	Drug that was, at one time, approved for weight loss in Europe, but not in the United States (approval has since been retracted)	Cartridge for e-cigarette labeled to contain rimonabant	Hadwiger et al, ²⁶ 2010 (FDA)
N-nitrosornicotine	Tobacco-specific	E-cigarette cartridge	Westenberger, ²⁵ 2009 (FDA)
N-nitrosoanabasine	Nitrosamines are strong carcinogens present in cigarette smoke		Laugesen ³³ (Health New Zealand) ^a
N-nitrosoanatabine			
4-(methyl)-nitrosamino)-1-(3-pyridyl)-1-butanone			
Anabasine	Pyridine alkaloid found in the tree tobacco (<i>Nicotiana glauca</i>) plant, a close relative of the common tobacco plant (<i>Nicotiana tabacum</i>)	E-cigarette cartridge	Westenberger, ²⁵ 2009 (FDA)
Myosmine	Alkaloid found in tobacco	E-cigarette cartridge	Westenberger, ²⁵ 2009 (FDA)
β -nicotyrine	Alkaloid derived from the dehydrogenation of nicotine	Cartridge and vapor	Westenberger, ²⁵ 2009 (FDA)
Diethylene glycol	An ingredient used in antifreeze Toxic to humans	E-cigarette cartridge	Westenberger, ²⁵ 2009 (FDA)
Ethyl alcohol	Many volatile organic compounds can cause health effects	E-cigarette cartridge and vapor	Laugesen ³³ (Health New Zealand) ^a
Acetaldehyde			
Acetone	Many volatile organic compounds can cause health effects	Vapor	Laugesen ³³ (Health New Zealand) ^a
Cresol			
Xylene			
Styrene			
Formaldehyde	Carcinogen	E-cigarette cartridge Vapor	National Evidence-based Healthcare Collaborating Agency (Korean government) Laugesen ³³ (Health New Zealand) ^a

Abbreviation: USFDA, US Food and Drug Administration.

^a Industry-supported.

Data from Refs. 20,25,26,33

requesting that they publish the link to the survey. Most participants reported using e-cigarettes to quit smoking or avoid relapse (77%) or deal with withdrawal or cravings (67%). Users also shared that e-cigarettes were less expensive than smoking (57%), and they perceived them to be less toxic than tobacco (84%). Limitations included selection bias and a potential for oversampling satisfied or heavy/long-term users.

McQueen and colleagues⁶ interviewed a very small convenience sample of participants (N = 15) attending the Midwest Vapfest in St. Louis and other meetings of the Midwest Vapers Group. Participants were interviewed in small groups or individually. Some recurring themes were that (1) friends, advertisements, and internet sites were common ways of learning about e-cigarettes; (2) learning to use e-cigarettes is complex; (3) perceived benefits of e-cigarette use included decreased cost, close approximation to the traditional smoking experience, weight control, fewer negative health effects, and increased ability to be physically active; (4) participants reported reduced nicotine tolerance and dependence; and (5) participants were interested in reading about and participating in advocacy and research. A unique language that mixed technical, pseudo-technical and popular jargon was observed. The authors noted that future research is urgently needed to compare e-cigarettes with both nicotine replacement products and traditional cigarettes.⁶ Contrary to findings in Benowitz's²¹ review, McQueen and colleagues⁶ claim that nicotine contributes to few of the long-term health problems of smoking, as does Rodu,⁸ in his article entitled "The Scientific Foundation for Tobacco Harm Reduction."

Capponetto and colleagues³⁷ presented a case study of two smokers treated at a smoking cessation clinic who were clinically depressed and had a history of relapse. At a follow-up visit, both reported using e-cigarettes to quit smoking on their own (quit status measured objectively). Both clients had abstained from smoking traditional cigarettes for at least 6 months at the time of the report.

Other studies describe the pharmacokinetics and pharmacodynamics of e-cigarettes. Bullen and colleagues³⁸ randomized 40 adult dependent smokers to four study groups: e-cigarettes with 16 mg of nicotine, e-cigarettes with 0 mg of nicotine, nicotine inhaler, or usual brand of cigarette. No difference was seen in the desire to smoke between the 16-mg e-cigarette and nicotine inhaler groups, but subjects reported less mouth and throat irritation with the e-cigarette. The pharmacokinetic profile with the 16-mg e-cigarette was similar to that with the nicotine inhaler. Vansickel and colleagues³⁹ studied 32 smokers assigned to four independent Latin-square ordered conditions differing according to product (own brand traditional cigarette, e-cigarette with 18-mg of nicotine, e-cigarette with 16 mg of nicotine, or an unlit cigarette). Neither e-cigarette exposed users to measurable nicotine or carbon monoxide, and neither increased heart rate. E-cigarettes produced some reduction in withdrawal symptoms, although less than their own brand.

Trichounian and colleagues⁴⁰ used a smoking machine to conclude that taking stronger puffs was needed to smoke e-cigarettes than regular cigarettes and that the puff strength needed to be increased over the course of using the e-cigarette. Characteristics such as puff strength and aerosol density varied widely within and between e-cigarette brands.

THE ROLE OF E-CIGARETTES IN THE "HARM REDUCTION" DEBATE

Well-formulated evidence-based clinical practice guidelines exist for tobacco dependence treatment, but, at best, the abstinence rates for people using these treatments remain low.^{41,42} Tobacco use is a chronic, relapsing disease involving addiction to nicotine.⁴³ One way to treat tobacco addiction is to suggest a variety of approved, effective cessation medications, including nicotine delivery devices. However, therapeutic nicotine replacement products are slower and less efficient at delivering nicotine, which makes their use less satisfying to most users than the tobacco product. Nicotine in a traditional cigarette is delivered to the brain in 10 seconds when inhaled, but absorption ranges from minutes to hours when nicotine gum, lozenges, or patches are

used.^{43,44} There is no question that tobacco smoke and tobacco products are harmful.⁴⁵ However, a harm reduction debate exists in the public health community.⁴⁶ The associations between smoking and cancer and heart and lung disease are well-known and established among both smokers and nonsmokers. However, the health effects of other tobacco products, such as electronic cigarettes, are not as widely known, among both the public and scientists.⁷

Just as harmful effects of cigarettes took many years to discover, the relative safety or harm of the myriad of new tobacco products entering the market under the guise of harm reduction will take time to determine. Mass-produced and mass-marketed cigarettes were a 20th century experiment on the public health that has impacted the world like no other product before or after their development. Cigarettes are the single leading cause of preventable death, and an urgent response to the public health crisis is needed.⁴⁷

The US Surgeon General has clearly stated that no safe level of exposure to tobacco smoke exists,⁴⁵ but limited scientific research is available on the safety of the vapor from e-cigarettes. Nor has adequate scientific research been performed on the effects of nicotine and the other chemicals in e-cigarette cartridges. E-cigarette advocates and manufacturers market the product as safer than conventional cigarette smoking. However, more research is needed to determine the safety and efficacy of e-cigarettes.

The e-cigarette industry has much to gain financially by promoting the harm reduction message.¹¹ Most smokers want to quit and many have tried without ultimate success, but smoking rates remain disproportionately high for some segments of the population.⁴⁸ E-cigarettes are an attractive option when coupled with a message of being less harmful, particularly as the cost of cigarettes and smoke-free environments continues to increase. Nonindustry studies are beginning to explore the effects of e-cigarette use on health and smoking cessation, but current findings are far from conclusive.^{38,49} Despite the lack of research, sales of electronic cigarettes continue to rise.

Tobacco cessation experts cite the need for sound scientific studies, not market-driven data, to explore the potential efficacy of e-cigarettes or similar devices in helping people quit smoking.⁴ If these devices can be shown to help more people quit completely, this would represent a true reduction of harm for users and the population as a whole. However, no scientific basis currently exists for making claims of either reduced harm or safety for e-cigarettes. Furthermore, e-cigarette use has potential unintended consequences, such as youth appeal, leading to increased smoking initiation, or dual use of different tobacco products by a single user, derailing the potential for ultimate smoking abstinence.

OTHER CONCERNS

Henningfield and Zaatari²² suggest that e-cigarettes may undermine smoke-free laws, cessation attempts, and prevention efforts. Specific concerns include (1) nicotine absorption does not mimic that of cigarettes and therefore e-cigarettes may not help smokers quit, (2) claims of safety to the user or to others breathing the emissions have not been verified; and (3) products delivering very low levels of nicotine may become "starter products" for nonsmokers, especially youth. Yamin and colleagues⁴ elaborated on concerns for youth and young adults, a population that may respond to e-cigarettes being marketed as "green" and "healthy." Young children may be at high risk for toxicity from flavored cartridge refills containing lethal doses of nicotine.^{4,34} Cahn and Siegel,⁵⁰ who support e-cigarettes as a promising harm reduction product, acknowledged that existing research does not establish the absolute safety of e-cigarettes. Additionally, concerns about abuse liability have been raised. Although very

few participants used e-cigarettes for the delivery of other substances, a YouTube video shows how to refill the cartridge with marijuana hash oil.^{5,36}

REGULATORY AND POLICY ISSUES

Trichourian and Talbot²³ evaluated five brands of e-cigarettes, finding potentially serious hazards in design, labeling, and print materials supplied with products or online; some examples follow. Cartridges leaked, and spent cartridges still contained liquid with dangerous nicotine. Loading cartridges may lead to dermal nicotine exposure, and nicotine-containing liquid from spent cartridges may leak onto surfaces, where carcinogens can form from exposure to air. Cartridge labels did not clearly communicate the amount of nicotine or the expiration date, nor any warnings about nicotine. Other issues included dead batteries, incorrect flashing codes, incorrect filling of orders, and inaccurate instructions and advertisements. A pervasive lack of quality control exists in the manufacturing, marketing, and distribution of e-cigarettes. The WHO calls for the study of pharmacokinetics, safety and efficacy trials, and approval by drug regulatory agencies.⁵¹ Studies would include a complete description of the ingredients, concentrations of chemicals delivered to the consumer, comparisons of cessation outcomes, and identification of adverse effects. Yamin and colleagues⁴ call for monitoring of biologic, social, and addictive effects and of online promotions of e-cigarettes. WHO further recommends that national health surveys monitor e-cigarette use and that practitioners counsel patients against using e-cigarettes.⁵¹

Henningfield and Zaatari²² concur with the WHO's recommendation that e-cigarettes be covered under smoke-free laws and tobacco-free policies. Without evidence that e-cigarettes and their emissions are safe, increasing numbers of agencies, companies, and governments are including e-cigarette use in their smoke-free policies. For example, the Air Force and the Marine base at Quantico prohibit use of e-cigarettes in the workplace, and New Jersey and Suffolk County, NY, prohibit their use wherever smoking is prohibited.⁵² The US Department of Transportation now applies the federal regulation against smoking on aircraft to e-cigarettes.¹² Canada, Australia, Brazil, and Panama have prohibited e-cigarettes entirely because of safety and regulatory concerns.⁴ King County, Wash, and Tacoma Wash, limit e-cigarette use inside public places¹² and four Kentucky communities prohibit use of e-cigarettes in public places and workplaces.⁵³ Six states and six communities prohibit e-cigarette sales to minors.¹² Americans for Nonsmokers' Rights urges university campuses to prohibit use of e-cigarettes as a part of their tobacco-free campus policies.⁵⁴

RESEARCH AGENDA

The scarce scientific evidence available indicates that toxic and carcinogenic compounds are present in e-cigarettes, although in lower concentrations than in traditional cigarettes. Actual contents vary widely, even among e-cigarettes of the same label, and the labeling does not always reflect the contents. More rigorous chemical analyses are needed, as are animal studies and clinical trials in humans to test the safety and efficacy of e-cigarettes.²

Standardization of the products and regulation of manufacturing practices are needed before research can be conducted. Otherwise, the variability in cartridge and vapor content may jeopardize study results, minimizing generalizability.⁷ As of September 2011, e-cigarettes were marketed legally in the United States without clinical trials, and the companies developing them were not likely to have the resources for adequate testing. As a precondition for safety and efficacy research on e-cigarettes, Eiter and colleagues⁷ call for an urgent need to develop resources for testing and a legal

framework in which manufacturers are licensed and accountable to manufacturing regulations. Without this standardization, the rapidly evolving e-cigarette technology means new products constantly arrive on the market, making research obsolete at the time of publication. Applying this legal framework not only has the potential to remove unsafe products from the market but also may contribute to the safety and efficacy of new smoking cessation drugs and devices that could save lives.⁷ Unfortunately, the United States seems to be in the middle of another grand experiment on the public's health, driven by the marketplace rather than science.

SUMMARY AND NURSING IMPLICATIONS

Hundreds of small companies produce e-cigarettes, which are not currently regulated in the United States as drugs or drug delivery devices. Based on a recent court decision, the FDA can and will regulate e-cigarettes as tobacco products (unless marketed as making therapeutic claims) and less scrutiny will be applied, despite preliminary findings that they contain toxic ingredients varying widely among and within brands. Furthermore, consumers are not adequately informed because the ingredients may not be represented accurately on the label. Even if companies do not officially market e-cigarettes as cessation aids, numerous online consumer testimonies give the impression that e-cigarettes can help smokers quit and that use of e-cigarettes should be permitted anywhere. Some authors have supported the use of e-cigarettes, citing harm reduction as the rationale, despite the dearth of evidence about what the cartridges or vapor contain or whether the products are safe or effective. Design and manufacturing issues further exacerbate safety concerns for users and their families. Very little is known about e-cigarette emissions and no standardized way to study the vapor is available. Many authors call for further research, but standardization of the product and its manufacture is needed before research findings can be generalized beyond a particular brand and batch of e-cigarettes. Funding is needed for non-industry-sponsored research, because most small companies do not have the resources. However, the potential exists to add another well-tested, safe, and effective cessation product to the public health arsenal. As Etter and colleagues⁸ suggest, sound research would form empiric bases for decisions made by regulators, elected officials, health care providers, and consumers.

Kuschner and colleagues¹⁹ recommend that clinicians inform patients that e-cigarettes are not approved as cessation devices by the FDA and that no evidence supports that they help smokers quit. The investigators urge clinicians to use strategies recommended by the Public Health Service–sponsored Clinical Practice Guideline⁴¹ and the telephone quitlines: 1-800-QUIT-NOW. Cobb and Abrams⁵ concur, also recommending that patients wishing to use nicotine as a quit strategy be directed to one of the many FDA-regulated and safe forms of nicotine replacement, along with other effective tools, such as Web-based services. Kuschner and colleagues¹⁹ further suggest informing clients that using e-cigarettes may give children and teens the impression that “vaping” is harmless. The authors also note that millions of people (more than half of ever-smokers alive today) have achieved long-term abstinence.¹⁹ In conclusion, nurses need to direct tobacco users to evidence-based quit strategies and cessation products; support inclusion of e-cigarettes in smoke-free policies and prohibiting sales to minors; and advocate for further research and surveillance of the use and marketing of e-cigarettes.

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