Teen vaping: Time to clear the air

Vaping has escalated at alarming rates among adolescents and young adults. It’s time to educate teens about the hidden health risks of these innocuous nicotine delivery systems.

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The vaping culture of using non-cigarette tobacco and electronic nicotine delivery systems (ENDS) is the latest risky trend among adolescents and young adults. Vaping is the use of high-tech, advanced electronic devices such as electronic cigarettes (e-cigarettes), refillable atomizers, and other tobacco products as an alternative or in addition to regular cigarettes. A concerning 10-fold to 11-fold rapid rise noted in middle and high school students poses dangers of nicotine exposure to the pediatric population.

This article will explore the risk-taking behavior of adolescents engaging in vaping; the effects of vaping and the indiscriminate use of nicotine products on the young; and strategies that healthcare providers can use to collaborate with patients and families to reduce their risk of harm from this emerging public health epidemic.

Background

The first e-cigarette was conceptualized and patented in 1965 by Herbert Gilbert as a safe and harmless modality to smoking cigarettes. In 2003, an electronic atomizer version was patented by Ruyan Technology in China, marketed to the United States in 2007, and touted as a healthier alternative to smoking conventional cigarettes. Since the emergence of Ruyan’s first-generation e-cigarette, novel models have emerged in design, engineering, and nicotine delivery methods resulting in second-, third-, and fourth-generation ENDS delivery devices.

Modern generation devices have included mid-sized e-cigarettes known as personal vaporizers (PVs), which are similar to a pen or laser pointer. The advanced personal vaporizers (APVs) contain a mechanical firing device called a “mod” (short for “modification”) that may be used in conjunction with different atomizers (tank systems), and they vary in size, shape, and delivery methods. The most innovative and advanced devices, however, are regulated “vape mods,” which contain an internal circuitry. Lingo used among the diversity of delivery devices includes vapes, vape pens, e-cigs, e-hookahs, mods, and tank systems.

Regardless of the novel delivery devices, use of nicotine-containing products in any form presents...
dangers and is unsafe.  

Escalation of misuse

Vaping is a significant public health concern and has escalated at alarming rates among adolescents and young adults. During 2011-2012, data from the National Youth Tobacco Survey revealed a modest increase in e-cigarette use (used 1 or more times within the past 30 days) among students in grades 6 to 12, from 1.1% to 2.1%. From 2011 to 2014, the use of e-cigarettes grew rapidly to 13.4% of high school students and 3.9% of middle school students. By 2014, e-cigarettes had become the most frequently used tobacco product among young persons, exceeding conventional cigarette use. In 2015, over 3 million middle school and high school students reported e-cigarette use, equating to 1 in every 6 school students, and over 25% reported trying e-cigarettes.

In young adults aged 18 to 24 years, e-cigarette use (used 1 or more times within the past 30 days) more than doubled from 2013 to 2014 to 13.6%, and as of 2014, more than one-third had tried e-cigarettes. E-cigarette use data among teenagers and young adults represent the various product types of ENDS.

What the vaping culture entails

Vaping refers to the vaporization of substances (nicotine, flavorings, cannabis, or other substances in popularity) wherein oil, liquid, or plant material is heated to a temperature resulting in the release of aerosolized water vapor and active ingredients (nicotine, cannabis) delivered via inhaled aerosol. Tremendous controversy has arisen surrounding potential harm reduction or risks associated with e-cigarettes/vaping in young persons.

Nicotine, a highly addictive substance in any form, is commonly vaped. Health effects of nicotine include hemodynamic effects secondary to catecholamines (eg, increase in heart rate and blood pressure; vasoconstriction of arteries and vessels; endothelial dysfunction; atherosclerosis acceleration). During adolescence while the brain is developing, nicotine can result in addiction and harmful consequences such as behavioral and cognitive impairments, memory issues, inattention, and executive function impairments.

Recommended: Consumer buy fewer cigarettes after CVS stops selling them

Harmful effects have been found from e-cigarette aerosol and additives. Brief exposure to propylene glycol aerosol has been reported to be a respiratory and eye irritant in patients without asthma. Contemporary generations of high-powered e-cigarettes comprising tank systems have the capacity to heat nicotine liquids to high temperatures that produce cancer-causing carcinogens such as formaldehyde and acetaldehyde in the vapor. Metals detected in some e-cigarette aerosol, including lead, silver, tin, nickel, iron, copper, and cadmium, may be products of the heating element (coil).
Secondhand e-cigarette aerosol exposure to nicotine, particles, and potentially toxic chemicals have been found in emissions studies.\(^3\) The effects of potentially harmful doses of heated and aerosolized ingredients of e-cigarette liquids including solvents, flavorings, and toxicants are not fully understood.\(^4\)

Dual use of vaping nicotine and smoking cigarettes presents added health concerns.\(^3,4\) An association has been identified in young persons between e-cigarette use and the propensity to use other tobacco products, in particular the use of combustible products (ie, cigarettes).\(^4\) To illustrate, 58.8% of high school students in 2015 reported using e-cigarettes and additionally combustible tobacco products.

The evolving landscape of recreational and medicinal marijuana (cannabis) use has given rise to an increase in vaping cannabis.\(^5,7\) In 2017, a study conducted among 3847 high school students in Connecticut was consistent with high rates of using e-cigarettes to vape cannabis (lifetime cannabis user, 18%; lifetime dual users, 26.5%).\(^7\) Besides the potential for nicotine addiction, addiction risk exists for cannabis and other illicit drug use.\(^4\) Little is known about the long-term health effects of vaping and even less has been established about the potential harm of vaping other substances such as cannabis.\(^5\)

Targeted advertising

Robust marketing and colorful advertising campaigns directed toward the youth population through social media outlets, television, and on the Internet proliferated between 2011 and 2013.\(^3,6\) One study found television advertisements soared 256%, reaching over 24 million young persons.\(^3\) Appealing, child-friendly flavorings are a marketing endeavor to attract adolescents, disguise harsh tobacco, and facilitate nicotine addiction.\(^4,6\)

In 2014, 466 brands and 7764 distinctive flavors of e-cigarette products were available.\(^3,4\) Emerging evidence suggests that flavorings when vaporized at high temperatures result in chemical reactions of toxic levels of carbonyl compounds such as formaldehyde, although the health effects are not completely appreciated.\(^4,8\) Flavorings/taste were among the 3 most commonly reported reasons for e-cigarette use among teenagers and young adults along with perceived low harm as compared with conventional tobacco products and curiosity.\(^3\)

More: Helping teenaged smokers quit
Emerging evidence of use patterns has revealed that e-cigarettes are being utilized by young persons for various alternative behaviors such as smoke tricks, vape competitions, and vaping other substances including cannabis and cocaine.  

“Dripping” is one of the newest trends wherein e-liquid at high temperatures is manually applied directly on the atomizer coil and the vapor produced is inhaled. In the first study to evaluate prevalence rates for dripping conducted by Yale University on high school students (n=7045) from 8 different Connecticut schools, anonymous surveys evaluated tobacco use behaviors and perceptions. Results of the anonymous surveys revealed that 26.1% of e-cigarette ever users (n=1080) reported using the device for dripping, equating to 1 in 4 adolescents. Reasons for dripping included: thicker vapor clouds (63%); better-tasting flavors (38.7%); and a stronger hit produced in the throat (27.7%) by dripping. Safety studies are not available on the practice of dripping, although some research suggests e-liquid exposure may have a considerable increase in toxic vapors (eg, acetaldehyde, formaldehyde, acetone) and may increase exposure to high levels of nicotine.

Promoting public awareness

Adolescents encompass over 20% of the population in the United States. Harm reduction prevention and early interventions of risky behavioral patterns established during the developmental periods of youth are not only significant for influencing adolescents’ current health status, but also their future health status into adulthood. In 1 study in which teenagers were asked why they used e-cigarettes, more than half the students stated the main reason was simple curiosity. Of concern was that when asked what they were inhaling when vaping, more than 60% reported that they were vaporizing “just flavoring,” not realizing e-cigarettes contain nicotine. Only 10% of the adolescent research participants stated they were using e-cigarettes in an attempt to quit smoking regular cigarettes.

Another alarming problem is the increase (161% to 333%) in calls to poison control centers that involve children aged younger than 5 years suffering potentially fatal poisonings through the ingestion, inhalation, or absorption through the skin or eyes attributed to access to the liquid nicotine cartridges, which are not required to be childproof. Concentrations of e-liquid nicotine for refilling e-cigarettes are ample enough to result in a fatal overdose sometimes as high as 1000 mg/10 mL and are commonly sold
in colorful bottles or cartridges attractive to children.\textsuperscript{3,4}

**Recommended: Teens are using e-cigarettes to vaporize cannabis**

The use of ENDS has achieved notoriety to the adolescent population in particular via the Internet through social networking and by the promotion of tobacco products using viral strategies from tobacco companies that have been directly and indirectly marketing via social media.\textsuperscript{11} The traditional dissemination of research findings, health information, and regulatory actions using journal publications and government reports to stakeholders involved in this public health problem may need to be reconsidered.\textsuperscript{12} Technologic advancements with communication and advertising outlets may have implications for public health advocates who will need to explore alternative strategies to engage and inform the community at large on emerging health concerns, promotion, and prevention.

**Parental support and guidance**

A national endeavor issued by the office of the US Surgeon General, *E-Cigarette Use Among Youth and Young Adults*, outlines 6 goals and strategies to reduce e-cigarette use among adolescents and young adults.\textsuperscript{4} Strategies to accomplish these goals encompass areas where stakeholders (eg, individuals, parents/caregivers, families, teachers, coaches, youth influencers) can become involved. One way parents can engage is to become educated on the risk of e-cigarette use, enabling the parent/caregiver to educate their own children about the harmful effects of e-cigarettes, other nicotine products, and vaping of illicit substances. Being tobacco-free role models, opening discussions about the harms of tobacco and nicotine products, and protecting young persons from indirect exposure, such as tobacco smoke or aerosol from e-cigarettes, are illustrations.

**NEXT: Role of healthcare providers**

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Lack of knowledge can be a result of healthcare providers’ receiving little or no formal training in either their academic or practice settings on screening, treating, or providing referrals to young patients and their families in regard to vaping. Healthcare providers may not even be screening for the use these products. If asked about tobacco use, adolescents and young adults who are using these products may not consider them tobacco, and respond that they are not using them. A recommendation would be to add vaping to the electronic medical record’s tobacco screening tool when screening for tobacco use in the pediatric population.

Healthcare providers can play a key role both in clinical practice and as faculty in higher education. The provision of skills necessary to address the health and safety implications of pediatric nicotine use and exposure needs to be incorporated into clinical practicum course objectives. Education initiatives in medical and nursing practice can enhance the ability to assess and synthesize data, make clinical judgments, and initiate diagnostics decisions. The development of appropriate plans of
care and anticipatory guidance may be a sustainable, long-term solution related to this evolving public health epidemic.

Recommendations for policy and practice

Regulatory policy lagged behind the rapid revolution of e-cigarettes and vaping resulting in risk to children, adolescents, and young adults. In 2014, the US Food and Drug Administration (FDA) expanded regulatory authority under the Family Smoking Prevention and Tobacco Control Act of 2009 to include all tobacco products including e-cigarettes and hookahs. Concerns by public health advocates exist because the proposed regulations do not include regulations of marketing practices or flavored nicotine products targeting young persons. E-cigarettes presented a paradigm shift in the tobacco landscape. Vaping has gained huge popularity among the younger population and is an area wherein expanded tobacco control policies and enhanced surveillance of current and emerging patterns of use are needed.

Next: Should 16 be the age for e-cigarette purchases?

Although recent regulations are now restricting the sale of these products to minors nationwide, the marketing of these products in colored refill packages and in a variety of candy flavors is aimed at attracting the younger generation with the misperception of being a harmless habit. Added hazards include a rise in vaping other substances such as the concoction of chemicals, cannabis, or synthetic drugs. Legalization of medical marijuana and recreational marijuana use in some states are reasons rooted in escalating use of vaporized cannabis use among youth. Emerging patterns of alternative use, such as dripping in 1 in 4 high school students, support the need for regulations and restrictions on e-cigarette devices to avoid easy manipulation for novel experimentation.
Globally, taxation has been used as an effective means to reduce cigarette consumption. with approximately a 10% increase in price resulting in a 1% decrease in smoking prevalence. There is wide variability in the taxation of non–cigarette tobacco products in some markets where ENDS have not been subject to tobacco taxes. Consumers, particularly adolescents, may seek more cost-effective products, thus switching to other tobacco products or substituting related ENDS. The FDA could evaluate risk/exposure claims providing opportunities for tax advantages to products as a way to draw users away from more hazardous products. Such regulations could also bring about changes in non–cigarette tobacco products that could impact public health by reducing attractiveness and/or toxicity.

Summary

There is the potential risk that public misperceptions and regulatory practices do not often coincide with the actual risk for tobacco products. The pervasive tobacco control movement based on strong science has been instrumental in driving numerous policy changes. Some of these positive strategies include indoor smoking restrictions, advertising bans aimed at children, taxation (providing an economic disincentive for smokers to continue), and education. These effective methods can influence strategies regarding the use of non–cigarette tobacco products that may result in beneficial outcomes in public health for the future.
REFERENCES


