



Technology Department

E-cigarettes and Vaping: What Do Pediatric Nurses Need to Know?

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It seemed like a good idea at the time when electronic cigarettes (e-cigarettes) were introduced to the market in 2006–2007 as a lower risk alternative for adults who smoke tobacco and as an aid in smoking cessation (Binns, Lee, & Low, 2018; Jaber et al., 2018). At the time, because e-cigarettes were not considered tobacco products they were not regulated by the Food and Drug Administration (Curran, Burk, Pitt, & Middleman, 2018; FDA, 2010). Coincidentally, just seven years ago the authors of this column suggested the use of e-cigarettes for use in conjunction with smoking cessation programs to help teens “kick the habit” (Goldschmidt & Hasson, 2012). At the time the Center for Disease Control and Prevention (CDC, 2010) reported that the rates of teen smoking had stopped declining, had leveled off, and that the goal to reduce teen smoking to less than 16% (U.S. Department of Health and Human Services, 2000) had not been achieved. The idea seemed plausible since technology appeals to teens, using e-cigarettes, where the dose of nicotine is lowered over time, in conjunction with a smoking cessation program run by professionals might appeal to this age group. Although altruistic, in 2010, suggesting an intervention using e-cigarettes may have been too late. At the same time e-cigarettes were being marketed to teens at candy counters in convenience stores and became available in hundreds of different flavors.

The appeal of e-cigarettes is highest among U.S. youth. Today the U.S. faces a public health crisis of epidemic proportions, the use of e-cigarettes among teens has the potential to create another generation addicted to nicotine (FDA, 2018; LaMotte, 2018). This column will focus on the use of electronic nicotine delivery systems (ENDS) in the adolescents, a review of the current types of ENDS, the prevalence of health risks from vaping, vaping's potential as a gateway agent, federal regulations in place and those still needed to protect minors, and implications for pediatric nurses.

Electronic nicotine delivery systems (ENDS)

To *vape* means to use a device to inhale vapor or mist into the lungs. ENDS used for *vaping* are referred to as e-vaporizer, vape pens, e-hookah, e-cigarettes and e-pipes (Miech, Johnston, O'Malley, Bachman, & Patrick, 2019). ENDS use an “e-liquid” that is heated to create an aerosol that is inhaled by the user. The liquid may contain nicotine, just flavoring, or nicotine and flavoring.

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The U.S. has seen a dramatic increase in ENDS use which has become particularly popular with adolescents. The prevalence of vaping in teens went from almost 0% in 2011 to the most common form of tobacco delivery in 2017 (Miech et al., 2019). In 2018, 3.62 million middle and high school students were current ENDS users, with an increase of 1.5 million students from 2017 to 2018 (FDA, 2018). Also, those teens who reported using ENDS are using the product more frequently with an overall weekly increase of 20% to 27.7% within the past year (FDA, 2018).

“Research shows youth and young adults identify flavors as a primary reason for ENDS use” (FDA, 2018, para. 5). Today there are over 7000 flavors available for ENDS (Allen et al., 2016). Advertising is another factor that increases ENDS use in teens. Convenience stores with tobacco displays and advertising were shown to increase a teenager's willingness to use ENDS by 15% compared to stores that did not display tobacco and advertising (Preidt, 2018).

Health risks in ENDS users

ENDS use is most common in adolescents who have never smoked; this group has a higher likelihood of becoming a cigarette smoker later in life (Jaber et al., 2018). Since ENDS entered the market recently, there is limited research on the long-term effects of use. It is known that early exposure is associated with the development of chronic conditions later in life, particularly damage to the pulmonary endothelium (Binns et al., 2018). Exposure to air pollution and inhaled toxins can lead to asthma and chronic obstructive pulmonary disease. Studies have shown that ENDS can be toxic and damage pulmonary endothelium (Binns et al., 2018). Research has also shown that ENDS are associated with elevated diastolic blood pressure, increased respiratory resistance and increased risk of respiratory infections (Stroup & Branstetter, 2018). Also, ENDS that contain nicotine can increase the heart rate.

Beyond the concern for nicotine exposure, are the unknown health risks associated with chemical exposure related to inhaling flavored vapor (Allen et al., 2016). There is a dearth of research on the effects of inhaling flavoring chemicals. Researchers selected 51 different flavors of e-flavored cigarettes that are popular among teens; 39 contained diacetyl which is associated with bronchiolitis obliterans, also called “popcorn lung” (Allen et al., 2016). Bronchiolitis obliterans is a lung condition caused by damage to the smallest airways which results in coughing, wheezing and shortness of breath (American Lung Association, 2018). Currently, there are no safe exposure guidelines for inhaled food flavoring compounds (i.e., diacetyl) available for children. What is

also important to consider is that with the child's smaller body size, the overall exposure to inhaled chemicals from ENDS is at a much higher level than that of an adult (Allen et al., 2016).

There have been several case reports of adults who have been diagnosed with eosinophilic pneumonitis, acute hypersensitivity pneumonitis, lipid pneumonia and one case of acute respiratory distress syndrome following ENDS use (Sommerfeld, Weiner, Nowalk, & Larkin, 2018). A case report by Sommerfeld et al. (2018) reports an 18-year-old woman who presented to the emergency department with dyspnea, cough, and pleuritic chest pain after initiating ENDS use three weeks before the symptoms. She was intubated for respiratory failure and required norepinephrine for perfusion and bilateral chest tubes due to pleural effusions. She was eventually diagnosed with hypersensitivity pneumonitis, was treated with steroids, recovered and was discharged from the hospital (Sommerfeld et al., 2018). Although hypersensitivity pneumonitis is typically caused by microbial antigens, it can be triggered by chemical exposure such as the substances in ENDS (Sommerfeld et al., 2018). These case reports demonstrate that there can be, life-threatening risks from using ENDS.

Are ENDS a gateway to other substance use?

The adolescent brain is still developing and is vulnerable to nicotine addiction (FDA, 2018). It is suggested that exposure to nicotine during adolescence may cause changes in the central nervous system that could increase dependence and addiction to other substances (Dai, Catley, Richter, Goggin, & Ellerbeck, 2018). Adolescents that smoked tobacco or used ENDS had higher rates of using alcohol or other substances compared to those who were nonusers (Curran et al., 2018). The risk of substance use was associated with the type of product used; ENDS have the lowest risk, tobacco smoking has an intermediate risk, and dual users have the highest risk (Curran et al., 2018). Barrington-Trimis et al. (2018) showed that students who were ENDS users had four-fold higher odds for becoming a tobacco smoker.

There is an association between ENDS use and marijuana use. This association is much stronger in younger adolescents, age 12–14 who use ENDS, compared to older adolescents, age 15–17; heavy users of ENDS were more likely to become heavy users of marijuana (Dai et al., 2018). The earlier onset of ENDS users, under the age of 14, is significantly associated with an increased risk of cigarette smoking and other substance use (McCabe, West, & McCabe, 2018).

Adolescent's perception of the safety of ENDS

Adolescents may not possess the knowledge needed about the potential harm from ENDS. Bernat et al. found that "43% of youth reported that e-cigarettes were less harmful than cigarettes" (2018, p. 365). This study also found that less than half of the participants thought ENDS could harm them and nearly 40% did not know or were not sure if someone could become addicted to ENDS (Bernat, Gasquet, O'Dare Wilson, Porter, & Choi, 2018). Adolescent users of ENDS have a misperception about the nicotine content. Half of the nicotine ENDS users and more half of the non-nicotine ENDS users believe that the nicotine they used was artificially made and was safer than the nicotine extracted from tobacco plants (Pepper, Farrelly, & Watson, 2018). This study also showed that ENDS users who did not vape with nicotine were less knowledgeable about ENDS and were not sure how to tell if the e-liquid had nicotine (Pepper et al., 2018). ENDS are marketed as being safer than smoking tobacco, but nicotine is still an addictive substance whether used in an ENDS product or smoked, and ENDS will expose the user to potentially toxic substances.

FDA regulations

In May 2016, the FDA expanded regulation to include ENDS producers to list the ingredients in e-liquids, report the possible and

recognized adverse effects, prohibit sales to children under the age of 18 and to post warning labels on the product and in advertising (Curran et al., 2018). In 2018, the FDA initiated action directed against retailers and manufacturers of ENDS which included warning letters and financial penalties. The new rules for ENDS regulation included checking photo identification of anyone under the age of 27, prohibiting the sale of ENDS to anyone under the age of 18, barring the sale of tobacco products from a vending machine or supplying free samples to consumers (FDA, 2019, February 5).

FDA regulations needed

The FDA is considering other measures to make tobacco products less harmful and attractive to youth including limiting flavor and advertising that would appeal to adolescents, require child-resistant packaging and labeling to prevent unwanted exposure to children (FDA, 2019, February 7).

Pediatric nursing implications

Nurses, nurse practitioners, and physicians need to ask their pediatric patients about tobacco and ENDS use. Studies have shown that receiving counseling regarding tobacco use has been linked with 47% higher adjusted odds of an attempt at smoking cessation within the year, but that only a third of adolescents report being asked about tobacco use by their provider (Dai & Clements, 2018). The American Academy of Pediatrics issued a policy statement in 2011 recommending all adolescents be screened for alcohol, tobacco and drug use which increased screening from 32.2% in 2011 to 37.9% in 2013 (Dai & Clements, 2018). Screening for substance use by pediatric providers has remained constant at 36.6% from 2013 to 2015 (Dai & Clements, 2018). Screening rates among younger adolescents age 9–14 have remained unchanged whereas there has been increased screening in the age group 15–17 (Dai & Clements, 2018). This is concerning as several studies indicate that the use of ENDS under the age of 14 is associated with a higher likelihood of imitating tobacco smoking or marijuana (Dai & Clements, 2018; Jaber et al., 2018; McCabe et al., 2018; Vogel, Ramo, & Rubinstein, 2018). ENDS use can start as early as seven years old, so it is imperative to begin anticipatory guidance and counseling before adolescence (Dai et al., 2018).

Screening for ENDS and tobacco use is not enough, as screening alone has not been shown to lead to smoking cessation attempts (Dai & Clements, 2018). Health care providers need to educate and counsel their pediatric patients about the health care risks associated with ENDS, inhaling flavored vapor, and nicotine. This should include the possibility of damage to the lungs and brain (Sommerfeld et al., 2018; Stroup & Branstetter, 2018), and that ENDS may lead to tobacco smoking or marijuana use (Barrington-Trimis et al., 2018; Binns et al., 2018; Curran et al., 2018; Dai et al., 2018; McCabe et al., 2018).

Furthermore, Vogel et al. (2018) found that frequent ENDS use is linked to being introduced to vaping by a family member, consistently using nicotine in ENDS, having friends who use ENDS and using customizable devices. Health care providers should ask about the frequency and amount of nicotine and the use of ENDS by friends and family.

Summary

The U.S. faces a public health crisis of epidemic proportions, the use of e-cigarettes among teens has the potential to create another generation addicted to nicotine (FDA, 2018; LaMotte, 2018). The use of e-cigarettes among teens has become an epidemic which has the potential to create another generation addicted to nicotine (FDA, 2018; LaMotte, 2018). Electronic nicotine delivery systems (ENDS) is used for vaping and are referred to as e-vaporizer, vape pens, e-hookah, e-cigarettes and e-pipes (Miech et al., 2019). To vape means to use a device to inhale vapor or mist into the lungs. ENDS use an "e-liquid" that is heated to

create an aerosol that is inhaled by the user. The liquid may contain nicotine, just flavoring, or nicotine and flavoring. Beyond the concern for nicotine exposure, are the unknown health risks associated with chemical exposure related to inhaling flavored vapor (Allen et al., 2016).

The long-term effects of ENDS use are not known. Many recent studies show that there can be harmful or even life-threatening effects from ENDS. Other research demonstrates that ENDS use can be a gateway to tobacco smoking, marijuana, and other substance use. ENDS use among middle and high school students has surpassed tobacco smoking with about 30% of youth using these products. Nurses, nurse practitioners, and physicians who care for pediatric patients need to screen for ENDS use and counsel and educate patients about the risks of using these products.

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