Electronic Cigarettes the Past, Present and Future

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CE Credits: 2 hours
Intended Audience: Dentists, Dental Hygienists, Dental Assistants, Office Managers, Dental Students, Dental Hygiene Students, Dental Assistant Students
Date Course Online: 10/01/2014  Last Revision Date: 1/19/2018  Course Expiration Date: 1/18/2021
Cost: Free  Method: Self-instructional  AGD Subject Code(s): 158
Online Course: www.dentalcare.com/en-us/professional-education/ce-courses/ce451

Disclaimer: Participants must always be aware of the hazards of using limited knowledge in integrating new techniques or procedures into their practice. Only sound evidence-based dentistry should be used in patient therapy.

Introduction
Knowledge about electronic cigarettes (e-cigarettes) among healthcare professionals is limited. This continuing education course will provide an overview of e-cigarette use, key components, mechanism of action, chemical composition, current safety, government regulations and the dental professional’s role in education and recommendations.

Conflict of Interest Disclosure Statement
• The authors report no conflicts of interest associated with this course.

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Overview

Some former smokers are using e-cigarettes as a way to help them quit smoking traditional cigarettes; however, health claims and claims of efficacy for quitting smoking are unsupported by the scientific evidence to date. Dental professionals need to be aware of the health risks associated with this electronic nicotine delivery system (ENDS). The subsequent information will provide an overview of the history of e-cigarettes, components, chemical composition, prevalence and how dental professionals can become involved in education and recommendations.

Learning Objectives

Upon completion of this course, the dental professional should be able to:

• Understand the origin and development of electronic nicotine delivery systems (ENDS) or “e-cigarettes.”
• Identify the components and mechanism of action of ENDS.
• Identify the chemical composition of the Nicotine Inhalant (“E-juice”).
• Determine the current demographics of e-cigarette users.
• Recognize the dental professional’s role in appropriate education and recommendations.
• Understand current safety and government regulations regarding ENDS.
• Identify the current knowledge about the effects of ENDS on oral health.

Introduction

Smoking tobacco affects nearly every part of the body; it increases health risks, incidence of cancer, cardiovascular and respiratory disease and early death. In the past 20 years there have been major efforts in preventive measures to stop consumers from smoking tobacco. In response to these dangers, the U.S. government issued health warnings, product labeling, mass media campaigns, Surgeon General Warnings, bans on advertisements, nationwide programs and clean indoor air laws regulated by the government.

Recently there has been a growing trend towards a new type of device where cigarette smokers have supplemented their use of traditional cigarettes with an electronic nicotine delivery system (ENDS) or “electronic cigarette” (e-cigarette) to receive nicotine without the damaging effects of tobacco. The evidence available at this time, although limited, points to high levels of dual use of e-cigarettes with conventional cigarettes, with no proven cessation benefits. The literature is clear on the dangers of smoking and chewing tobacco, but little is known among health professionals and the public about the use of e-cigarettes.

If e-cigarettes are, in fact, the new rising trend and are used along with or to replace traditional cigarettes, there are more questions that need to be addressed: What is the prevalence of e-cigarette use? What are the risks and benefits of replacing traditional cigarettes with e-cigarettes? What are the federal regulations regarding the manufacturing of this product? What are the components of an e-cigarette?

Having a better understanding of this product will help guide the dental professional in providing accurate information regarding the use of e-cigarettes to their patients.

The History of E-cigarettes

The first smokeless, non-tobacco cigarette device was patented by Herbert A. Gilbert from Beaver
Falls, PA in 1967. This non-tobacco cigarette was thought to be a safe and harmless method of smoking by replacing burning tobacco and paper with heated, moist, flavored air.¹

In 2003, a Chinese pharmacist, Hon Lik, was credited with the first generation e-cigarette that used a piezoelectric element to vaporize the liquid containing nicotine diluted in a propylene glycol solution.³⁶

Hon Lik invented the e-cigarette as a safer and cleaner way to inhale nicotine as a tobacco cessation resource, after his father passed away from lung cancer.²

By 2004, Hon Lik introduced e-cigarettes to the Chinese market through his employer, the Golden Dragon Holdings. Later the company changed its name to Ruyan meaning “almost like smoke” to resemble its product.⁴

After the success of e-cigarette sales in Asia, products were sold through the internet in large quantities. E-cigarettes gained popularity in many different countries. In 2007, e-cigarettes were introduced to the American market.⁵ The major tobacco companies that have purchased or developed e-cigarette products include: Lorillard acquired Blu, the leading e-cigarette brand in the United States. Altria acquired GreenSmoke and has its own Mark Ten brand, and Reynolds created its own brand Vuse. Additionally, British American Tobacco sells Vype, Imperial Tobacco sells Ruyan, and Swisher sells E-Swisher. Logic and NJOY are also leading e-cigarette companies. In the United States, e-cigarette sales have grown at an annual rate of 115 percent in the 2009-2012 period. It is estimated that the global e-cigarette market could increase to $10 billion by 2017.⁴¹ In August 2013, a leading tobacco analyst predicted that booming e-cigarette sales in the U.S. will more than double this year, hitting $1.7 billion.⁴²

**The Basic Components of E-cigarettes/ENDS**

Many ENDS products are designed to look like traditional tobacco cigarettes in an effort to replicate the visual, sensory, behavioral and social aspects of smoking. Additionally, many other electronic devices that deliver nicotine and/or other substances have been developed including disposable e-cigarettes, rechargeable e-cigarettes, pen-style medium-sized rechargeable e-cigarettes (sometimes called “vape pens”), tank-style large-sized rechargeable e-cigarettes, e-cigars, e-pipes, and e-hookah.⁴⁸ The e-cigarette is composed of three main components: a rechargeable lithium battery, vaporizing chamber and a cartridge that contains the liquid nicotine.⁷

The lithium battery is the most critical part of the e-cigarette and responsible for activating the device to charge the atomizer inside the cartridge. The vaporizing chamber, also known as the atomizer, is responsible for vaporizing the nicotine liquid within the cartridge. Attached to one end of the battery is a LED indicator light; the indicator light becomes active when the user inhales. The e-cigarette then triggers the display of the red light; once the smoker stops inhaling or if the battery charge is low, the indicator light will switch off.⁸

To activate an e-cigarette, the user will either press an activation button or merely inhale against the device causing an air flow to signal the inbuilt sensor within the lithium battery to activate the vaporizing chamber. The vaporizing chamber converts the liquid nicotine in the cartridge into a vapor, which is then inhaled by the user. Upon exhalation and coming into contact with the moisture in the outside air, the vapor condenses resulting in a thick visible fog.

The e-cigarette industry continues to evolve, new products are quickly developed and brought to the market. Since 2003, when the first generation e-cig was first introduced by Hon Lik three generations have followed. First generation e-cigarettes resemble traditional

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Fig. 1.
making up stainless steel cylindrical box. The device has a temperature regulating system and lower resistance coils (Sub Ohm) to produce bigger more flavorful vapors.

There are two major types of nicotine cartridges available for use in an e-cigarette. Most basic cartridges are disposable cartomizers. These cartridges are prefilled with e-liquid. Once the cartridge is used up, it is thrown away and requires replacement with a new cartridge.

cigarettes, they are cheap easily accessible and often times disposable. The second generation or “mid-size” e-cigs tends to be more favored towards experienced e-cig users. They are considerable larger, rechargeable and consist of two parts, a separate tank and a battery.

Unlike the first generation e-cigs, the second generations contain a clearomizer and not an atomizer. The clearomizer was developed in 2009, it was the first technology that contained the wiking material, reservoir and the atomizer coil all within one single unit.

Third generation e-cigarettes are essential a larger type of the second generation e-cigs. They are often referred as modifications e-cigs or “mods” the device comes in a variety of shapes and sizes, typical a box or cylindrical shape, where the user can customize tank, how much e-liquid is contained and the voltage or power the device can output.

The fourth and most recent generation that is developed, are considered the most powerful and advanced device on the market. Typically

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Some Brands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disposable e-cigarette</td>
<td>Cigarette-shaped device consisting of a battery and a cartridge containing an atomizer to heat a solution (with or without nicotine). Not rechargeable or refillable and is intended to be discarded after product stops producing aerosol. Sometimes called an e-hookah.</td>
<td>NJOY OneJoy, Aer Disposable, Flavorvapes</td>
</tr>
<tr>
<td>Rechargeable e-cigarette</td>
<td>Cigarette-shaped device consisting of a battery that connects to an atomizer used to heat a solution typically containing nicotine. Often contains an element that regulates puff duration and /or how many puffs may be taken consecutively.</td>
<td>Blu, GreenSmoke, EonSmoke</td>
</tr>
<tr>
<td>Pen-style, medium-sized rechangeable e-cigarette</td>
<td>Larger than a cigarette, often with a higher capacity battery, may contain a prefilled cartridge or a refillable cartridge (often called a clearomizer). These devices often come with a manual switch allowing to regulate length and frequency of puffs.</td>
<td>Vapor King Storm, Totally Wicked Tornado</td>
</tr>
<tr>
<td>Tank-style, large-sized rechargeable e-cigarette</td>
<td>Much larger than a cigarette with a higher capacity battery and typically contains a large, refillable cartridge. Often contains manual switches and a battery casing for customizing battery capacity. Can be easily modified.</td>
<td>Volcano Lavatube</td>
</tr>
</tbody>
</table>

**Figure 2.** Examples of different electronic cigarette (e-cigarette) products. Reproduced from: Grana et al.}

**Figure 3.** A bottle is filled with nicotine “juice” solution at an e-cigarette factory in China.
Understanding the Prevalence and Trends of E-cigarette Use

The awareness and use of e-cigarettes is increasing. E-cigarettes are advertised in magazines, convenience stores, internet websites and social media networks.\textsuperscript{2} E-cigarette advertisement rose from $6.4 million in 2011 to $115 million in 2014.\textsuperscript{7}

Their high-tech design, wide variety of flavors and easy availability are sold via mall kiosks, convenience stores, online websites and retail outlets making e-cigarettes desirable to youth and young adults.\textsuperscript{13,20} A typical starter kit, which contains the e-cigarette device, a battery and several cartridges, can cost anywhere from $30 to $100, depending on the manufacturer, model and style. And then there's the cost of the cartridges. The cost of a year's worth of replacement cartridges for sustaining the equivalent of a pack-a-day habit will cost about $600.\textsuperscript{9}

E-cigarettes have also been endorsed by celebrity spokespeople such as Jenny McCarthy and Stephen Dorff. E-cigarettes are being seen more frequently in public by actors, including Leonardo DiCaprio, Katy Perry, Bruno Mars and many more.\textsuperscript{14-16}

According to the Philadelphia Department of Public Health, in 2010, 40% of adults were aware of e-cigarettes and 10% of tobacco smokers had used an e-cigarette recently. In 2011, this number rose to 60% of adults aware of e-cigarettes with 21% of smokers having used an e-cigarette recently. While e-cigarette usage increased for all groups that were studied, including young adults, the sharpest increases were seen among non-Hispanic Caucasians aged 45–54 years, in both current and former smokers.\textsuperscript{17}

The National Center of Biotechnological Information (NCBI) published information gained from two surveys that were conducted in 2010: a national online study (n = 2649) and the Legacy Longitudinal Smoker Cohort (n = 3658). Multivariable models were used to examine e-cigarette awareness, use, and harm perceptions.\textsuperscript{18}

The results of the two studies found that 40.2% of participants had heard of e-cigarettes, with the highest awareness being among current tobacco smokers. Utilization of e-cigarettes was higher among current tobacco smokers (11.4%)
than in the total population (3.4%). In addition, 2.0% of former tobacco smokers were now using e-cigarettes and 0.8% of those who had never used tobacco were now using e-cigarettes. In both surveys, non-Hispanic Caucasians, current smokers, young adults, and those with at least a high-school diploma were most likely to perceive e-cigarettes as less harmful than regular cigarettes. The article recommended product regulation and careful surveillance to monitor public health impact and emerging utilization patterns.

Etter and Bullen studied the profile, utilization, satisfaction and perceived efficacy of e-cigarettes. They determined the awareness of the product is high in the adult population and the most common reasons for using e-cigarettes (as stated by consumers) is to help with cravings, to use less toxic alternatives to regular cigarettes, to avoid relapse, and to attempt to cut down or quit smoking.

Bullen, et al, evaluated the use of e-cigarettes for tobacco cessation and concluded that among smokers wanting to quit, nicotine e-cigarettes might be as effective as patches for achieving cessation at 6 months. Additionally, they identified no difference in adverse events with e-cigarettes as compared to the patches.


Among all high school students, current use of any tobacco product did not change significantly from 2011 (24.2%) to 2016 (20.2%); however, a nonlinear decrease occurred in current use of any combustible tobacco product (21.8% to 13.8%), tobacco products (12.0% to 9.6%), cigarettes (15.8% to 8.0%), cigars (11.6% to 7.7%), and smokeless tobacco (7.9% to 5.8%), and a nonlinear decrease occurred in current use of pipe tobacco (4.0% to 1.4%) and bidis (2.0% to 0.5%). A nonlinear increases occurred for current use of e-cigarettes (1.5% to 11.3%) and hookahs (4.1% to 4.8%).

During 2011–2016, among middle school students, a linear decrease occurred in current use of any combustible tobacco products (6.4% to 4.3%), cigarettes (4.3% to 2.2%), cigars (3.5% to 2.2%), and pipe tobacco (2.2% to 0.7%).

However, during 2015–2016, among high school students, decreases occurred in the use of any tobacco product (25.3% to 20.2%), any combustible tobacco product (17.2% to 13.8%), ≥2 tobacco products (13.0% to 9.6%), e-cigarettes (16.0% to 11.3%), and hookahs (7.2% to 4.8%).

August 8, 2016, the FDA finalized its rule, giving them jurisdiction over the regulation, manufacturing, distribution and marketing of tobacco products, including e-cigarettes, cigars, pipe tobacco, and hookah tobacco. Implementation of comprehensive tobacco control and prevention strategies at CDC-recommended funding levels Tobacco prevention and control strategies at the national, state, and local levels likely have contributed to the reduction in use of certain tobacco products, including e-cigarettes, among youths in recent years.

The Food and Drug Administration (FDA) warned of health risks posed by e-cigarette use. Reported concerns included:

- More than 3 million middle and high school students were current users of e-cigarettes in 2015, up from an estimated 2.46 million in 2014.
- Sixteen percent of high school and 5.3 percent of middle school students were current users of e-cigarettes in 2015, making e-cigarettes the most commonly used tobacco product among youth for the second consecutive year.
- During 2011-2015, e-cigarette use rose from 1.5 percent to 16.0 percent among high school students and from 0.6 percent to 5.3 percent among middle school students.
- In 2013-2014, 81% of current youth e-cigarette users cited the availability of appealing flavors as the primary reason for use.
- In 2014, 12.6% of U.S. adults had ever tried an e-cigarette, and about 3.7% of adults used e-cigarettes daily or some days.

## Safety and Regulation of E-cigarette Use in the U.S.

The safety of this product is still in question. In 2009, the Food and Drug Administration’s Center for Drug Evaluation, Division of Pharmaceutical
Analysis (DPA) conducted a preliminary analysis of 18 of the various flavored nicotine and no-nicotine cartridges. The contents were tested for ingredients potentially being carcinogenic or harmful to humans. The samples detected:

- 1% diethylene glycol, an ingredient used in antifreeze and toxic to humans.
- Tobacco specific nitrosamines, a chemical compound which are human carcinogens were detected in 50% of the samples.
- Tobacco specific impurities: anabasine, myosmine, and β-nicotyrine, which are all carcinogens.
- The e-cigarette cartridges that were labeled as containing no nicotine had low levels of nicotine present.

However, due to variability among products, the analysis could not draw specific conclusions about what substances are or are not present in particular liquid nicotine samples.

Two other research papers concluded e-cigarettes vapors do, in fact, contain some trace amounts of impurities or toxic substances that were stated on the product labels and were much lower than the amount found in traditional cigarettes and, therefore, less harmful to the...
Initially the FDA sought regulation of e-cigarettes as drugs or drug delivery devices. The above timeline follows the development of regulation.

- **2008:** The FDA moved regulation of e-cigarettes as drugs or drug delivery devices by blocking importation of new e-cigarette shipments into the U.S.
- **2009:** Major e-cigarette manufacturer (Sottera), sued the FDA claiming that the “agency didn’t have the authority over e-cigarettes as drugs or drug delivery devices and therefore could not stop shipments from entering the country.”
- **January, 2010:** District court agrees with the manufacturer determining that FDA may not regulate e-cigarettes as a drug or drug delivery device.
- **December, 2010:** The FDA appealed the lower court’s ruling. The circuit court upheld the decision. FDA has no regulatory authority to regulate e-cigarettes.
- **April 25, 2014:** FDA issued a proposed rule that would extend its tobacco product authority to cover additional products including e-cigarettes.
- **August 8, 2016:** FDA finalized a rule to regulate all tobacco products, extends its regulatory authority to all tobacco products, including e-cigarettes, cigars, and hookah and pipe tobacco, as part of its goal to improve public health.

States vary in terms of use and regulation of e-cigarettes, with some states and localities having implemented a Smoke-Free Workplace Law by requiring more indoor workplaces to be smoke free and prohibit smoking within 10 feet of entrances, exits, windows that open, and ventilation intakes of workplaces or public places. However, most states do not include e-cigarettes in this category of smoke free environments.

“Before this final rule, these products could be sold without any review of their ingredients, how they were made, and their potential dangers, under this new rule, we’re taking steps to protect Americans from the dangers of tobacco products, ensure these tobacco products have health warnings, and restrict sales to minors.” Explains Mitch Zeller, J.D., director of the FDA’s Center for Tobacco Products.

It requires health warnings on roll-your-own tobacco, cigarette tobacco, and certain newly regulated tobacco products and also bans free samples. In addition, because of the rule, manufacturers of newly regulated tobacco products that were not on the market as of February 15, 2007, will have to show that products meet the applicable public health standard set by the law. And those manufacturers will have to receive marketing authorization from the FDA.

The new rule also restricts youth access to newly regulated tobacco products by: 1) not allowing...
products to be sold to those younger than 18 and requiring age verification via photo ID; and 2) not allowing tobacco products to be sold in vending machines (unless in an adult-only facility).

It's important to note that FDA regulation of these products does not mean they are safe to use. But before this rule, there was no federal law to stop retailers from selling e-cigarettes, hookah, or cigars to youth under age 18.

It is recommended that health professionals contact local governmental agencies to determine if rules and regulations have been implemented against the use of e-cigarettes in their respective states. Also, health professionals can use online resources that track state and local legislation.

**Oral and Systemic Effects of ENDS/ E-cigarette Use**

Growing evidence from research suggest potential gum and tissue damages from e-cigarette vapors. In an letter published in the New England Journal of Medicine, researcher expressed concern over formaldehyde in e-cigarette aerosols. During the “vaping” process aerosols in “vaped” e-cigarettes are converted into formaldehyde-releasing agents inhaled in the pulmonary system increasing an inflammatory and oxidative responses leading to tissue damage in e-cigarette users. The study also examined e-cigarette flavorings used in the cartridges also known as “e-juices”. The flavors with more of a triggered inflammatory response were coming from cinnamon, vanilla, and buttery flavored e-juices How the aerosols behave in the respiratory tract is unknown, but formaldehyde is an International Agency for Research on Cancer group 1 carcinogen.

In another study, Irfan Rahman, a Ph.D. professor of Environmental Medicine at the UR School of Medicine and Dentistry, published the first scientific study in Oncotarget a biomedical journal covering research on all aspects of oncology. In his research it addressed e-cigarettes and their detrimental effects on oral health. Rahman explained, that “We showed that when the vapors from an e-cigarette are burned, it causes cells to release inflammatory proteins, which in turn aggravate stress within cells, resulting in damage that could lead to various oral diseases,” Rahman who also published a study last year about the damaging effects of e-cigarette vapors and flavorings on lung cells and an earlier study on the pollution effects. “How much and how often someone is smoking e-cigarettes will determine the extent of damage to the gums and oral cavity.”

Fawad Javed, a post-doctoral student at Eastman Institute for Oral Health, part of the UR Medical Center, who contributed to the study stated “It's important to remember that e-cigarettes contain nicotine, which is known to contribute to gum disease.”

In one 2011 study, Polosa, et al found 6% of patients reported mouth irritation; 8% sore throat and dry mouth; and 9% mouth ulcers after 4 weeks of use. After 8 weeks, 8% reported coughing and after 24 weeks, 8% had throat irritation and 7% dry mouth.

The FDA posts adverse event reports it has received concerning electronic cigarettes since 2008. To date, 115 adverse events concerning e-cigarettes have been reported, including four reports of mouth irritation and/or gums bleeding.

It is well known traditional cigarettes have many health risks associated with its use. Upon inhalation of tobacco smoke, the dry heat produced from the cigarette causes a hypoxic (dry) environment that is detrimental to the oral cavity. If there are, in fact, no toxic chemical substances in the ENDS solution, but the smog production causes a dry environment within the oral cavity, are e-cigarettes a better alternative?

At this time, overall research demonstrates a relatively low incidence of adverse oral effects; however, more long-term studies are needed to fully assess this device.

Systemic effects of e-cigarette use also needs further research. Goniewicz, et al evaluated the vapors from 12 brands of e-cigarettes. The study found the vapors contained 9-450 times lower toxic substances than that of traditional tobacco cigarettes. However, although data is limited, it is clear that e-cigarette emissions are not merely “harmless water vapor,” as is frequently claimed,
and can have negative health impacts and be a source of indoor air pollution.\textsuperscript{43}

The nicotine levels in the blood stream are unclear and vary depending on the research. Levels range from a similar level to that of cigarettes and others indicate a lower blood nicotine level. More research is indicated in this area.

It is known that nicotine, at high levels, can be lethal. ENDS cartridges contain concentrated nicotine, ranging from 6mg-24mg. If a child were to ingest the nicotine from an ENDS cartridge, acute nicotine poisoning, and possibly death, could result.\textsuperscript{34} Indeed, in April 2014, a CDC study reported that the number of calls to poison centers involving e-cigarette liquids containing nicotine rose from one per month in September 2010 to 215 per month in February 2014.\textsuperscript{63}

**Negative Health Impacts of E-cigarettes and Problems with Dual Use**

It is suggested both duration (years of cigarette use) and intensity (cigarettes per day) determine the negative health effects of smoking.\textsuperscript{43}

The 2014 report of the US Surgeon General concluded that “reducing the number of cigarettes smoked per day is much less effective than quitting entirely for avoiding the risks of premature death from all smoking-related causes of death.”\textsuperscript{64}

The use of electronic cigarettes by cigarette smokers to cut down on the number of cigarettes smoked per day is likely to have much smaller beneficial effects on overall survival compared with quitting smoking completely.\textsuperscript{43}

This situation is particularly likely to exist for cardiovascular disease. Light smoking, even 1 to 4 cigarettes per day, is associated with markedly elevated risk of cardiovascular disease.\textsuperscript{65} In addition, e-cigarettes deliver loads of fine particles similar to those of conventional cigarettes. Above certain intensity, the specific levels of exposure may not cause significant differences in risk for cancer. Doll and Peto\textsuperscript{66} found a dose-response relationship between duration of smoking and number of cigarettes smoked per day and risk of lung cancer, with models suggesting the impact of duration to be greater than that of intensity. Using participants from the Cancer Prevention Study II, Flanders et al\textsuperscript{67} found a greater increase in lung cancer mortality with a greater duration of cigarette smoking compared with a greater intensity of smoking. Overall, this data suggests that lung cancer mortality increases more with additional years of smoking than additional cigarettes per day. Thus, if dual use of e-cigarettes and cigarettes results in reductions in the number of cigarettes per day for current smokers, any reduction malignancy risk will be less than proportional to the reduction in cigarette consumption because of the (likely larger) importance of duration of smoking.\textsuperscript{43}

“Even though e-cigarettes are known to be much less harmful for health than tobacco smoking products, nobody knows what their long-term health and addiction consequences might be.”
– Roswell Park Cancer Institute, Buffalo, New York

**The Dental Professional’s Role in the Education and Recommendations**

E-cigarettes may be a gateway to nicotine use, they can increase the use of conventional cigarettes, which clearly have significant health and dental impacts. Dental professionals should understand the general concepts of e-cigarettes and, specifically, any health risks associated with this new device. Should it be recommended as an alternative method of tobacco cessation? Through open communication and trust the clinician can actively engage in conversations with the patient to identify the pros and cons of using e-cigarettes. The more informed dental professionals are on this specific topic, the more information they can provide their patients of healthier alternatives, especially with children and adolescents. This knowledge, presented in a non-judgmental atmosphere, will make the dental professional a valuable asset in a patient’s willingness to attempt change.

Dental professionals should consider having educational information regarding ENDS available in their offices. Having this information
readily available to patients will more likely open discussion between the patient and clinician.

**Conclusion**
Information on e-cigarettes is very limited and can be confusing, so having the basic understanding of the mechanism of action, current regulation and health effects of this product will increase the knowledge of the dental professional. In the next few years it will be interesting to see the turn of events that e-cigarettes has in its role with tobacco users.
Course Test Preview
To receive Continuing Education credit for this course, you must complete the online test. Please go to: [www.dentalcare.com/en-us/professional-education/ce-courses/ce451/start-test](http://www.dentalcare.com/en-us/professional-education/ce-courses/ce451/start-test)

1. The first smokeless non-tobacco cigarette device was patented by __________.
   a. Hon Lik
   b. Herbert A. Gilbert
   c. Ruyan
   d. NJOY

2. __________ was credited with the first generation e-cigarette that used a piezoelectric element to vaporize the liquid containing nicotine.
   a. Hon Lik
   b. Herbert A. Gilbert
   c. Ruyan
   d. NJOY

3. All the major cigarette companies such as Altria, Reynolds and Lorillard market e-cigarettes now.
   a. True
   b. False

4. Most basic cartridges are called cartomizers, these cartridges are prefilled with e-liquid and they are disposable.
   a. True
   b. False

5. The liquid nicotine or the “E-Juice” contained in the cartridge is a solution of propylene glycol or vegetable glycerin (commonly used in conjunction), nitrogen, artificial flavoring and nicotine.
   a. True
   b. False

6. Propylene glycol and vegetable glycerin is __________ and additives in medicine.
   a. flavoring carrier in food products
   b. an ingredient in food coloring
   c. All of the above.

7. E-liquids commonly come in all of the following except __________.
   a. 24 mg
   b. 18 mg
   c. 12 mg
   d. 6 mg
   e. 54 mg

8. E-cigarettes are advertised in magazines, convenience stores, internet web sites and social media networks.
   a. True
   b. False
9. According to the Philadelphia Department of Public Health, in 2010, __________ of adults were aware of e-cigarettes and 10% of tobacco smokers had used an e-cigarette recently.
   a. 30%
   b. 40%
   c. 50%
   d. 60%

10. While awareness is high in the adult population and the most common reasons for using e-cigarettes as stated by consumers are to help with cravings, to use less toxic alternatives to regular cigarettes, to avoid relapse, and to attempt to cut down or quit smoking, e-cigarettes have not been shown to be effective for cessation.
   a. True
   b. False

11. E-cigarette use in the U.S. is currently regulated by the federal government, and may be legally sold in the United States under federal law.
   a. True
   b. False

12. The FDA posts adverse event reports it has received concerning electronic cigarettes since 2008. To date, __________ adverse events concerning e-cigarettes have been reported, including four reports of mouth irritation and/or gums bleeding.
   a. 115
   b. 120
   c. 125
   d. 130

13. At this time ENDS are a proven method to help in tobacco cessation and regulated by the FDA.
   a. True
   b. False

14. Growing evidence from research suggest potential gum and tissue damages from e-cigarette vapors that containing formaldehyde.
   a. True
   b. False

15. The flavors with more of a triggered inflammatory response were ________.
   a. Vanilla
   b. Cinnamon
   c. Buttery flavors
   d. All of the above.
References


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