ACTA SCIENTIFIC DENTAL SCIENCES (ISSN: 2581-4893)

Volume 3 Issue 2 February 2019

Review Article

Electronic Cigarettes: A Catch 22

Aarti Patel[1], Conor Campbell[2] and Allen Fielding[3]*

[1]*Intern Oral and Maxillofacial Surgery, Temple/Episcopal Campus, Philadelphia*

[2]*Third Year Student, Kornberg School of Dentistry, Temple/Episcopal Campus, Philadelphia*

[3]*Professor, Attending Surgeon, Temple/Episcopal Campus, Philadelphia*

***Corresponding Author:** Allen Fielding, Professor, Attending Surgeon, Temple/Episcopal Campus, Philadelphia.

Received: December 03, 2018; **Published:** January 17, 2019

Abstract

From the tobacco plants, *Nicotiana tabacum* and *Nicotiana rustica*, nicotine is presently the key ingredient used in electronic cigarettes (e-cigarettes). E-cigarettes are battery-operated devices that emit a vaporized form of nicotine (vape) compared to the traditional tobacco smoke. The marketing appeal of e-cigarettes is advertised as healthier than traditional cigarettes, less expensive, more socially acceptable and may possibly be used as a smoking cessation tool. A literature review, yielding 27 articles, was examined as to the validity of these claims. Results indicate that e-cigarettes presently contain increased nicotine content not as presently advertised over traditional cigarettes. While, nicotine is not a carcinogen, e- cigarettes contain 22 toxins that have shown to have deleterious health effects in animal studies. Additionally, the data is inconclusive on whether e-cigarettes may be used effectively as a smoking cessation tool or if it acts as a gateway drug to traditional cigarettes. There is a need to conduct larger long-term clinical trials to ascertain the potential uses and adverse effects of electronic cigarettes.

Keywords: Cigarettes; Tobacco; Smoke

Introduction

Nicotine is an alkaloid derived from the leaves of two different tobacco plants: *Nicotiana tabacum* and *Nicotiana rustica*. Binding to the nicotinic cholinergic receptors, nicotine results in the release of neurotransmitters including dopamine, norepinephrine, acetylcholine, serotonin, gamma-aminobutyric acid (GABA), glutamate, and endorphins. Nicotine also acts on receptors in the adrenal medulla leading to sympathomimetic activity affecting heart rate and cardiac contractility. Systemic effects of nicotine use include but are not limited to a transient increase in blood pressure and reduced insulin sensitivity [1]. Respiratory effects include increased mucus secretion, cilia inactivation, laryngeal and bronchial reactivity and small airway narrowing due to impaired tracheobronchial clearance. Habitual cigarette use reduces monoamine oxidase A and B activity, which increases dopamine and norepinephrine concentration in synapses, enhancing the effects of nicotine and leading to addiction. Nicotine produces temporary feelings of pleasure, when it subsides, users feel agitated and have nicotine withdrawal, causing them to use again. Nicotine is the primary addictive agent found in tobacco products, such as cigarettes, electronic cigarettes, dissolvable tobacco and chewing tobacco [1].

Tobacco use is the single greatest avoidable cause of disease and death worldwide [2]. Tobacco use was found to be a risk factor in six of the eight leading causes of death worldwide: ischemic heart disease, cerebrovascular disease, lower respiratory infections, chronic obstructive pulmonary disease, tuberculosis and lung cancers (tobacco use did not contribute to HIV/AIDS and diarrheal diseases) as some previous publications noted. Tobacco use kills approximately 5.4 million people a year from lung cancer, heart disease, and other illnesses [3]. Various tobacco replacement products have been developed, such as electronic cigarettes, stated to reduce the risks associated with smoking traditional nicotine

cigarettes.

Electronic cigarettes (E-cigarettes) are battery-operated devices that emit a vaporized nicotine solution for the user to inhale. The purpose of e-cigarettes is to provide a similar sensation to inhaling tobacco smoke minus the tobacco smoke. E- cigarettes contain a cartridge, which holds a liquid solution containing varying amounts of nicotine, flavorings, and other chemicals, as well as a heating element (the atomizer), a battery, and a mouthpiece used to inhale. Puffing activates the battery-powered heating device, which vaporizes the liquid in the cartridge. The person then inhales the vapor; thus, giving its' name vaping [4].

"Vaping," commonly referred to as e-cigs, hookah pens, or vape pens is now the most popular form of nicotine use among teenagers in the United States [4]. The appeal of e-cigarettes is its' claim to avoid many of the adverse health risks posed by smoking conventional cigarettes, its' cheaper, more socially acceptable, and that it may be used as a smoking cessation aid [4,5]. This paper

Methods

A literature search was conducted using online databases including Medline via PubMed and Google Scholar. The search strategy was as follows "electronic cigarette (s)," "e-cigarette (s)," "electronic nicotine delivery system (s)" and "safety profile," "risks," "smoking cessation," or "gateway drug." The search yielded 5, 361 articles. To be considered for inclusion, the article had to meet the following criteria:

1. Be written in English
2. Full-text of the article was available and accessible
3. Be a clinical trial or systematic review
4. Dealing partly or exclusively with benefits or adverse effect of e- cigarette use

A total of 1, 206 met inclusion criteria. Duplicate articles were excluded.

Article titles and abstracts (when titles provided insufficient detail) were screened for potential relevance. Articles then underwent a full-text review, which included a manual search of reference lists of selected articles to identify additional relevant publications. After completing a full-text review, 27 articles were deemed relevant for this analysis; articles selected for inclusion were published between 2006 and 2018.

Discussion

The marketing appeal of e-cigarettes is that it has fewer health risks than traditional cigarettes, is cheaper, more socially acceptable, and may be used as a smoking cessation tool [5,6]. When analyzing the health risks associated with e- cigarettes the amount of nicotine in e-cigarettes, other compounds included in e-cigarettes, and carcinogenic potential was examined.

Health Risks

Nicotine content

The level of nicotine exposure from use of e-cigarettes is highly variable on the brand and varies from person to person and puff to puff. Studies have found wide ranges in nicotine levels, inaccurate product labeling, and inconsistent nicotine delivery during product use [7]. E-cigarette cartridges and refill solutions tested contained between 14.8 and 87.2 mg/mL of nicotine and the measured concentration differed from the declared concentration by up to 50% [8-11]. Cheng reports that the FDA's Division of Pharmaceutical Analysis conducted repeat testing of three different e-cigarette cartridges with the same label and found nicotine levels varying from 26.8 to 43.2 μg nicotine/100 mL puff. Additionally, Cheng summarizes the current research on varying amounts of nicotine found in e- cigarettes [7]. Cheng's systematic literature review indicates that not only do nicotine levels vary across products of the same brand, but the nicotine content listed on the label of e-cigarette cartridges or refill solutions significantly differs from measured values [6,9,11].

E-cigarettes pose an increased risk of nicotine toxicity when compared to traditional cigarettes due to increased nicotine concentration in the e-cigarette cartridges [7]. Acute exposure to inhaled nicotine can result in dizziness, nausea or vomiting; when nicotine toxicity levels are present they can cause convulsions, heart palpitations, fainting, or even coma [12]. An increased number of nicotine poisoning exposures have been reported by the poison centers across the US due to the increased concentration of nicotine found in e-cigarettes [13]. The increase in possible routes of administration, due to its liquid form, likely contributes to the increased number of exposures.

Toxic Compounds

In addition to nicotine, 22 other toxic substances are present in the e- cigarette liquid cartridges and its' vapor. However, many studies have shown that these compounds were found in lesser

Literature	Matrix	Units	Nicotine level	Deviation from label*
Goniewicz., *et al.* [4]	Refill solution	mg	0 ± 0.0 to 25 ± 1.1	–75 to 28%
	Cartridge	mg	0 ± 0.0 to 19 ± 0.5	–89 to 25%
	Aerosol	mg/150 puffs	0.3 ± 0.2 to 8.7 ± 1.0	N.A.
Etter., *et al.* 13	Refill solution	mg/mL	N.D. to 29.0	–15 to 21%†
Kirschner., *et al.* [16]	Refill solution	mg/mL	14.8 ± 0.2 to 87.2 ± 2.7	–50 to 40%†
Cameron., *et al.* [15]	Refill solution	mg/mL	8.5 ± 0.16 to 22.2 ± 0.62	–66 to 42%†
Pellegrino., *et al.* [6]	Cartridge	% W/W	< 0.001 to 0.25	N.A.
	Aerosol	mg/m^3	< 0.01 to 6.21	N.A.
McAuley., *et al.* [11]	Indoor air	ng/L	538 to 8770	N.A.
Cheah., *et al.* [17]	Cartridge	mg/cartridge	0.00 to 15.3	–89 to 105%†
Trehy., *et al.* [7]	Refill solutions	mg/mL	0 to 25.6	–100 to 100%†
	Cartridge	mg/cartridge	0 to 21.8	–100 to 100%†
	Aerosol	µg/100 mL puff	0 to 43.2	N.A.
Cobb., *et al.* [8]	Cartridge	mg/cartridge	3.23 ± 0.5 to 4.07 ± 0.54	–80 to –77%†
	Aerosol	µg/35 mL puff	0.3 for puffs 11 to 50 to 1.0 for puffs 1 to 10	N.A.
Westenberger [9]	Cartridge	mg/cartridge	0.00 to 6.76	N.A.
	Aerosol	µg/100 mL puff	0.35 to 43.2	N.A.
Westenberger [10]	Refill solution	µg/mL	N.D. to 25.6	N.A.

Table 1: Summary of nicotine reported in refill solutions, cartridges and aerosols of e-cigarette products compiled by Cheng [6].

*Deviation from label=(measured value – labelled value) * 100/labelled value.

†Calculation performed by this analysis based on reported data in each study.

N.A., not available; N.D., not detected.

concentrations in e-cigarettes compared to traditional cigarette smoke [14-16]. Toxic compounds including nitrosamines, acetaldehydes, acetone and formaldehyde are absent or found in trace amounts in e-cigarette cartridges. However, the use of e-cigarettes depends on the heating of the cartridges, and this can induce additional chemical reactions and the formation of new compounds [17]. A study by the US Department of Health and Human Service of the Food and Drug Administration agency found that trace amounts of nitrosamines and diethylene glycol was found in e-cigarette vapor [17,18].

A study by Goniewicz., *et al.* demonstrates the various toxic compounds found in both cigarettes and e-cigarettes. Toxic compounds include formaldehyde, acetaldehyde, acrolein, toluene, and N-nitrosonomicotine [17]. Formaldehyde causes throat and eye irritation; long-term effects are associated with increased risk of nasal cancer and myeloid leukemia [19]. Among the known upper airway irritants commonly found in e-cigarette cartridges is glycerol, a compound that, when vaporized, potentiates the effects of other inhaled substances such as nicotine., increasing their efficacy [7]. Of note is that the quantity of these toxic compounds range from nine to 450 times less in e-cigarettes than compared to traditional cigarettes as outlined in Figure 2 [17], suggesting that e-cigarettes may be a safer alternative due to decreased exposure to toxins.

Toxic compound	Conventional cigarette (µg in mainstream smoke) [35]	Electronic cigarette (µg per 15 puffs)	Average ratio (conventional vs. electronic cigarette)
Formaldehyde	1.6 - 52	0.20 - 5.61	9
Acetaldehyde	52 - 140	0.11 - 1.36	450
Acrolein	2.4 - 62	0.07 - 4.19	15
Toluene	8.3 - 70	0.02 - 0.63	120
NNN	0.005 - 0.19	0.00008 - 0.00043	380
NNK	0.012 - 0.11	0.00011 - 0.00283	40

Table 2: Comparison of various toxins between traditional cigarettes and e-cigarettes conducted by Goniewicz *et al.* [17].

Carcinogen

E-cigarettes are less detrimental than tobacco smoke with regards to respiratory function [20]. The lack of tobacco combustion reduces the amount of toxic exposure to e-cigarette users [7]. E-cigarettes are said to have fewer health risks because they do not burn tobacco and have no tar or ash. Tar, found in cigarettes, accumulates in the lungs making individuals vulnerable to lung cancer and other respiratory issues. Lack of ash and tar also means that e-cigarettes do not pose a risk of staining to teeth and fingers like traditional cigarettes do.

Nicotine, the main ingredient found in e-cigarettes, is not a direct carcinogen [1]. However, heating of the e-cigarette cartridge generates toxic compounds as discussed earlier [17,21]. While the toxins found in e-cigarettes are significantly less than traditional cigarettes, animal studies demonstrate that this reduced quantity may be enough to produce deleterious health effects [1,20,21].

There is a common misconception that e-cigarettes have limited or no emissions to the environment following inhalation, which Shober et. al proves to be false. They did a study of particulate matter dispersed into a ventilated room following 2-hr vape sessions with varying liquid solutions. They found that the sum of all Polycyclic Aromatic Hydrocarbons (PAH) was between 30-90%, higher during vape sessions as opposed to the control. The more volatile PAH made up a larger portion of the total measured PAH

Tang found that e-cigarette smoke induces DNA damage in the lung, heart, and bladder of mice, as well as inhibits DNA repair in the lung [20]. Nicotine, along with nitrosamine ketone, can induce DNA damage, inhibit DNA repair, enhance cell mutability, and yield tumorigenic cell transformation in cultured human lung and bladder cells [23]. Cardenia., *et al.* found that aerosols from e-cigarettes altered the lipid and cholesterol homeostasis in rat brains, which could contribute to the occurrence of neurodegenerative disorders [21]. Sood., *et al.* concluded that e-cigarette have the potential to produce similar pulmonary effects as those seen in the pathogenesis of asthma and COPD as evidenced in some in vitro and in vivo models [24]. While there is no clear delineation of e-cigarettes as a carcinogen, animal studies indicate that even reduced toxins can contribute to a variety of adverse health effects, but this has not been established in humans.

Cost

An average pack of traditional cigarettes in the United States costs about $7.04. An individual who smokes a pack per day will spend approximately $2,569.60 a year on traditional cigarettes. An e-cigarette cartridge costs around $9-10 per cartridges and is the equivalent to 2.5 packs of smokes. Since e-cigarettes are designed to last longer and don't have to be smoked in one sitting, an e-cigarette user will spend approximately $1,387 a year on disposable vapes. One e-cigarette cartridge will last as long as 20 packs of traditional cigarettes [25]. Thus, the cost of traditional cigarettes is much higher than an e-cigarette cartridge.

Popularity

Although the legal age to purchase or smoke cigarettes is 18 in the United States, E-cigarettes are common in younger age groups with 5.3% of middle school students and 16% of high school students reporting e-cigarette use in 2015 [26]. A study of high school students found that one in four reported using e-cigarettes for dripping, a practice in which people produce and inhale vapors by placing e-liquid drops directly on heated atomizer coils. Teenagers reported dripping creates a thicker vapor (63.5%), improves flavor (38.7%) and produces a stronger throat hit (27.7%) [27]. Since entering the market in 2004, e-cigarettes have become increasingly popular and available worldwide [5].

Many studies have focused on what consumers find appealing about e- cigarettes. Kong., et al. found that main reasons for using e-cigarettes among 127 middle school to college-aged kids was experimentation curiosity (54.4%), appealing flavors (43.8%), and peer influences (31.6%). Part of the appeal for adolescents to use e-cigarettes is their ability to do "cool smoke tricks" using the vapors. However, in the same study it is interesting to note, 16.3% of smokers discontinued e-cigarettes due to its' perception of being "uncool" [28].

Smoking Cessation

Success rates in attempts to quit nicotine-containing products vary. Success rates are generally lower for traditional cigarettes (around 10-11% when using nicotine gum, nicotine patch, varenicline or bupropion to assist with quit attempts) [1]. A meta-analysis by Sood., *et al.* finds that e-cigarettes may be effective in smoking cessation [24]. Trends from US population surveys over the last 10 years note an association between an increase in e-cigarette use and a concomitant increase in overall smoking cessation rates, suggesting the potential role of ECs as smoking cessation tools [24,29].

In one of the largest randomized clinical trials to date, 657 smokers were given 16-mg nicotine e-cigarettes, 21-mg nicotine patches, or a placebo e-cigarette and were followed for six months. Bullen., *et al.* found that even though tobacco cessation for the study population was less than predicted, resulting in insufficient power to draw conclusions, abstinence was highest in the group receiving 16-mg nicotine e-cigarettes (7.3% vs. 5.3% nicotine patches vs. 4.1 with placebo e-cigarettes) [24,30]. Goniewicz., *et al.* found that in a study of 179 Polish e-cigarette users, 41% used e-cigarettes as a means to quit smoking and for perceived reduction in harm. The use of e-cigarettes helped 66% stop smoking traditional cigarettes, while 25% reduced the amount of traditional cigarette use to less than 5 cigarettes a day [31]. According to the National Academies of Sciences, Engineering, and Medicine switching from traditional cigarettes to e-cigarettes completely will help with smoking cessation, but duel users will not have the same benefits [32]. At this time, the FDA has not approved of e-cigarettes as a smoking cessation tool.

Addiction

E-cigarettes are considered to be less addictive than traditional cigarettes. Out of 179 e-cigarette users, 60% believed that e-cigarettes were addictive, but less than traditional cigarettes [31]. The potential of a drug to cause dependency is correlated with the time between administration and the beginning of the central reward effects. In traditional cigarettes, inhaled nicotine reaches the central nervous system (CNS) within 20 seconds. In contrast, when using e-cigarettes, nicotine reaches the CNS within minutes, comparable to other nicotine replacement products [33]. Therefore, the addiction potential of e-cigarettes is extremely low.

Gateway drug

Gateway theory is the idea that the use of a presumably harmless drug leads to more harmful drug use [34]. A study by Bold., et al. showed that students who had used e-cigarettes by the time they started high school were more likely to start smoking traditional cigarettes within the year. Another study showed that high school students who used e-cigarettes within the last month were seven times more likely to report smoking traditional cigarettes within six months compared to students who did not use e-cigarettes [35]. Although there is limited data that proves that e-cigarettes will lead to the use of traditional cigarettes, there is growing concern that e-cigarettes may be a "gateway drug."

Conclusion

E-cigarettes market themselves based on fewer health risks, cost effectiveness, social acceptance, and use as a smoking cessation tool. An in-depth analysis of shows that e-cigarettes contain increased nicotine content than traditional cigarettes and from what is advertised. This poses an increased risk of nicotine toxicity, especially amongst dual users. While, nicotine is not a carcinogen, e-cigarettes contain other toxins in lesser quantity then traditional cigarettes. Animal studies have shown that even in lower doses these toxins may produce a variety of adverse health effects. A lack of evidence of adverse health effects in humans at this time does not equate to e-cigarettes having no risk. While e- cigarettes are cheaper than traditional cigarettes, they are becoming increasingly popular in younger individuals, indicating a need for increased prevention efforts toward the youth. Lastly, the data is inconclusive on whether e-cigarettes may be used effectively as a smoking cessation tool or if it acts as a gateway drug to traditional cigarettes. There is a need to conduct larger long-term clinical trials to ascertain the potential uses and adverse effects of electronic cigarettes. Due to wide variability of nicotine in e-cigarettes and varying rates of absorption in users it is difficult to conduct such trials reliably. This hurdle, presented by diverse device designs and e-liquid permutations contribute to the inconsistency of available data, also highlights the need for legislative standardization of

Bibliography

1. Learning B. "Nicotine and health". *DTB* 52.7 (2014): 78-81.
2. The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General, N.C.f.C.D.P.a.C.f.D.C.a. Prevention, Editor. (2006).
3. Organization WH. "WHO report on the global tobacco epidemic: the MPOWER package". Switzerland (2008): 329.
4. Brazier Y. "Are e-cigarettes a safe alternative to smoking?". *Medical News Today* (2018).
5. Oren Rom AP., *et al*. "Are E-cigarettes a safe and good alternative to cigarette smoking?". *Annals of the New York Academy of Science*s 1340 (2014): 65-74.
6. Cheng T. "Chemical evaluation of electronic cigarettes". *Tobacco Control* 23 (2014): ii11-ii17.
7. Callahan-Lyon P. "Electronic cigarettes: human health effects". *Tobacco Control* 23 (2014): 836-840.

8. Eissenberg T. "Electronic nicotine delivery devices: Ineffective nicotine delivery and craving suppression after acute administration". *Tobacco Control* 19 (2010): 87-88.

9. Goniewicz ML., *et al*. "Nicotine levels in electronic cigarettes". *Nicotine and Tobacco Research* 15.1 (2013): 158-166.

10. Nuan Ping Cheah., *et al*. "Electronic nicotine delivery systems: regulatory and safety challenges: Singapore perspective". *Tobacco Control* 23.2 (2014.).

11. Jean-Francois Etter., *et al*. "Analysis of refill liquids for electronic cigarettes". *Addiction* 108.9 (2013.).

12. Heller JL. "Nicotine Poisoning, in Medical Encyclopedia, D. Zieve, Editor. NIH U.S. National Library of Medicine MedlinePlus (2017).

13. Kevin Chatham-Stephens RL., *et al*. "Calls to Poison Centers for Exposures to Electronic Cigarettes - United States, September 2010 - February 2014". *Morbidity and Mortality Weekly Report* 63.13 (2014): 292-293.

14. Harmeet Singh Rehan JM and Amrit Pal Singh Hungin. "Vaping Versus Smoking: A Quest for Efficacy and Safety of E-cigarette". *Current Drug Safety* 13.2 (2018): 92-101.

15. Chad Cotti EN and Nathan Tefft. "The relationship between cigarettes and electronic cigarettes: Evidence from household panel data". *Journal of Health Economics* 61 (2018): 205-219.

16. Etter JF. "Levels of saliva cotinine in electronic cigarette users". *Addiction* 109.5 (2014.).

17. Maciej Lukasz Goniewicz JK., *et al*. "Levels of selected carcinogens and toxicants in vapour from electronic cigarettes". *Tobacco Control* 23.2 (2014): 133-139.

18. Westenberger B. "Evaluation of e-cigarettes, F.a.D.A. Department of Health and Human Services, Center for Drug Evaluation and Research, Division of Pharmaceutical Analysis, Editor. St. Louis, MO (2009).

19. Xiaojun Liang., *et al*. "Formaldehyde Exposure in Indoor Air from Public Places and Its Associated Health Risks in Kunshan City, China". *Asia-Pacific Journal of Public Health* (2018).

20. Tang Ms. "E-cigarette smoke exposure and effect in mice and human cells". *PNAS* 115.14 (2018): E3075-E3076.

21. Vladimiro Cardenia FV., *et al*. "The effect of electronic-cigarettes aerosol on rat brain lipid profile". *Biochimie* 153 (2018): 99-108.

22. Wolfgang Schober KS., *et al*. "Use of electronic cigarettes (e-cigarettes) impairs indoor air quality and increases FeNO levels of e-cigarette consumers". *International Journal of Hygiene and Environmental Health* 217.4 (2011): 628-637.

23. Hyun-Wook Lee., *et al*. "E-cigarette smoke damages DNA and reduces repair activity in mouse lung, heart, and bladder as well as in human lung and bladder cells". *PNAS (*2018): E1560-E1569.

24. Amika K Sood., *et al*. "Electronic cigarettes: One size does not fit all". *The Journal of Allergy and Clinical Immunology* 141.2 (2018): 1973-1982.

25. Glover L. "Are E-Cigarettes Any Better Than Smoking?". Nerdwallet (2014).

26. Baron C. "Electronic cigarettes (e-cigarettes) - Statistics and Facts". (2017): 75.

27. Scutti S. "Teens use e-cigarettes for 'dripping,' study says". *CNN* (2017).

28. Grace Kong., *et al*. "Reasons for Electronic Cigarette Experimentation and Discontinuation Among Adolescents and Young Adults". *Nicotine and Tobacco Research* 17.7 (2015): 847-854.

29. SH Zhu., *et al*. "E-cigarette use and associated changes in population smoking cessation: evidence from US current population surveys". *BMJ* 358 (2017): j3262.

30. Christopher Bullen CH., *et al*. "Electronic cigarettes for smoking cessation: a randomised controlled trial". *Lancet* 382 (2013): 1629-1637.

31. Maciej L., *et al*. "Patterns of electronic cigarette use and user beliefs about their safety and benefits: An internet survey". *Drug Alcohol Review* 32.2 (2013): 133-140.

32. Toussaint K. "Are e-cigarettes safe? Doctor lays out benefits and harms". Metro US (2018): 8.

33. Dennis Nowak RAJ. "Tobias Ruther, E-Cigarettes - Prevention, Pulmonary Health, and Addiction". *Deutsches* Ärzteblatt *International* 111.20 (2014): 349-355.

34. Kirsten Bell HK. "All gates lead to smoking: The 'gateway theory', e-cigarettes and the remaking of nicotine". *Social Science and Medicine* 119 (2014): 45-52.

35. Krysten W Bold., *et al*. "Trajectories of E-Cigarette and Conventional Cigarette Use Among Youth". *Pediatrics* 141.1

Volume 3 Issue 2 February 2019