



E-CIGARETTE
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E-Cigarettes: A Review of the Literature

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Authors and Contributors

This summary of the peer-reviewed literature on e-cigarettes was commissioned by the State of Alaska Tobacco Prevention and Control Program within the Division of Public Health in the Department of Health and Social Services. The literature review was produced by Program Design and Evaluation Services, a public health research group housed within the Multnomah County Health Department and Oregon Public Health Division, under contract with the Alaska Tobacco Prevention and Control Program. Report authors are Chris Bushore and Barbara Pizacani.

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Introduction

The development of a new, unregulated nicotine delivery device has opened a Pandora's Box of questions among tobacco control researchers. The debate over the safety and efficacy of electronic cigarettes among the tobacco control community has increased along with their use. As lab researchers analyze all of the constituents of the e-cigarette aerosol among the numerous brands, the tobacco control community is tasked with addressing the questions of e-cigarette use for cessation and harm reduction among traditional cigarette smokers. Moreover, concerns of the dangers of secondhand aerosol, increased nicotine dependence among dual users, e-cigarettes acting as a gateway to traditional cigarette addiction, renormalization of tobacco use, and the effects of unregulated marketing in social and traditional media must all be addressed. This paper is a compilation and summary of the relevant national and international research addressing these questions.

What are e-cigarettes?

E-cigarettes, also known as vape pens, e-hookahs, hookah pens, or vape pipes, are electronic nicotine delivery systems, invented in the early 2000s in China and introduced recently to the US market.¹ They consist of a battery, an atomizer with a heating element, and a cartridge containing nicotine and flavoring. When heated, the device produces an aerosol, also called a vapor by marketers. This has led to the use of the term “vaping” when using them, rather than smoke. The brands manufactured by Imperial Tobacco and RJ Reynolds (Blu, and Vuse) look very similar to cigarettes, while the refillable types look very different.

E-cigarettes are widely available both via the internet and retail settings including convenience stores where adolescents are particularly likely to frequent—about two-thirds of youth shop at convenience stores at least once a week.² In early 2014, there were 466 brands and 7764 unique flavors of e-cigarette products.³ Some of these flavors mimic candy – examples are Bubble Gum, Snicker Doodle, Gummy Bear, Mountain Dew, Captain Crunch, and Skittles.

- E-cigarettes are widely available and come in many flavors that are appealing to youth
 - There are 466 brands and 7764 different flavors – many candy-like

What is in e-cigarettes?

In general, they contain much lower levels of the harmful constituents present in conventional cigarettes. However, they do contain nicotine, an addictive and powerful psychoactive substance that acts in the brain and throughout the body.

Little internal quality control is present in the manufacture of e-cigarettes⁴ and currently, there is no external regulatory oversight of ingredients or packaging. Thus, there is wide variability in e-cigarette device engineering as well as differences in the nicotine concentrations of the

solutions (called e-liquids) that go into the device. The nicotine level listed on the labels of cartridges and solutions often differ significantly from measured values.⁵

Several studies have scientifically evaluated contents of the e-cigarette aerosol. One study analyzed the aerosol from 12 brands of e-cigarettes and compared the contents to those of a nicotine inhaler. Although toxic substances were found, they were 9-450 times lower than in cigarette smoke and were comparable in some cases to the nicotine inhaler.⁶ Another recent study also found that the toxic contents of e-cigarette aerosol differed greatly among brands.⁷ This variability in the contents of e-cigarette aerosol is a concern and has prompted the World Health Organization (WHO) to conclude that the regulation of e-cigarettes is a necessary precondition for the public to have reliable information on the potential risks and benefits of using e-cigarettes.⁸

- Among other contents, e-cigarettes contain nicotine, a highly addictive substance.
- There is no regulatory oversight of the contents of e-cigarettes and contents vary among manufacturers.
- There are no quality control measures and stated nicotine levels often differ from measured nicotine values.

Secondhand aerosol

In the U.S. an estimated 2.5 million nonsmokers have died from secondhand smoke since 1964. Eliminating smoking in all indoor areas is the only way to protect nonsmokers from secondhand smoke exposure.⁹ There is some evidence that the use of e-cigarettes in indoor areas poses an unnecessary risk to non-users. In one study, researchers noted that e-cigarettes are not emission free and that ultrafine particles from the aerosol can be deposited in the lung.¹⁰ The release of nicotine, ultrafine particles, and volatile organic compounds during e-cigarette use could enhance the risk of cardiac arrhythmias and hypertension.¹¹ In comparison to tobacco cigarettes, e-cigarettes are not a source of the combustion toxins associated with cigarette smoking, but are a source of secondhand nicotine, albeit at a concentration 10 times less than tobacco cigarettes.¹²

- E-cigarettes are not emission-free and a case can be made that the public should be protected from secondhand aerosol.
- E-cigarette aerosol is less toxic than tobacco smoke, though levels of toxins may vary.

How are e-cigarettes being marketed?

One of the major conclusions of the 2012 Surgeon General's report was that "Advertising and promotional activities by tobacco companies have been shown to cause the onset and continuation of smoking among adolescents and young adults".¹³ In the absence of regulation, the recent acquisition and creation of e-cigarette brands by tobacco companies has resulted in advertising tactics both in medium and message content which are shockingly similar to the banned cigarette marketing ads of yesteryear.¹⁴ These tactics included the use of celebrity endorsements and cartoon characters. A recent study collected Nielsen data on audience exposure to e-cigarette advertisements on T.V. and found that youth exposure to e-cigarette ads had increased 256% from 2011 to 2013, reaching 24 million youth; likewise, young adult exposure to e-cigarette ads increased by 321% over the same period.¹⁵ E-cigarette companies have been equally effective at marketing to adults, 8 of 10 U.S. adults are aware of e-cigarettes.^{16, 17} Awareness is highest among younger, white (as compared with Hispanic), and more educated current or former smokers.¹⁸ E-cigarette marketing may be specifically targeting some demographic groups including young adults, those with higher incomes and members of the lesbian, gay, and bisexual community.¹⁹

Not only are these ads making the public aware of e-cigarettes, they are also eliciting a desire for current smokers to try them. A recent study among current smokers who were shown an e-cigarette ad found that after viewing the ad the majority of respondents (88%) said that e-cigarettes were 'made for people like them' and two-thirds of the respondents indicated that they would try them in the future.²⁰ Smokers were most receptive to ads which emphasized the differences between e-cigarettes and tobacco cigarettes as well as ads showing a person using an e-cigarette.²¹

In addition to T.V. advertisements, e-cigarette companies have used social media including the internet, YouTube, and Twitter to market e-cigarettes. One study found that during a two month period in 2012, approximately 72,000 tweets were related to e-cigarettes and 90% of these were classified as commercial tweets originating from a small group of highly active accounts which included links to websites that sold e-cigarettes.²² A study which analyzed YouTube videos from 2008-2011 found that 85% of the videos were sponsored by marketers and these videos were seen by approximately 15.5 million people worldwide, of which 1.2 million are estimated to be under 18 years old. It is estimated that 30-50% of all e-cigarettes are sold via the internet and from August 2012 to January 2014 the number of brands increased by 10.5 per month to a total of 460 brands offering 7,700 flavors.²³ These studies have shown that e-cigarette companies have been effective at using both traditional and new social media to market their products much like the marketing tactics of the tobacco companies before regulation was implemented.

- E-cigarette companies are marketing their products aggressively in traditional and social media using many of the same pre-regulatory tactics used by tobacco companies which includes celebrity endorsements and the use of cartoon characters.
 - Youth exposure increased over 2.5 times between 2011 and 2013, reaching 24 million youth.
 - Young adult exposure tripled during the same time.
 - 80% of adults are also aware of the products.

Dual use and gateway to cigarettes

The introduction of several new noncombustible nicotine delivery devices within recent years has raised the alarm among the public health community. These new products which include e-cigarettes, snus, and dissolvables in a multitude of flavors and strengths can both increase dependence on nicotine for those already addicted and introduce new users to cigarettes. A recent study among current smokers found that although respondents reported using noncombustible tobacco products to cut down or quit cigarettes, only those who used snus were statistically significantly more likely to make a quit attempt within the past year. Use of e-cigarettes was not associated with a reduction in cigarettes per day or cessation among this group of current smokers.²⁴ Another recent study among Korean youth found that although current smokers who used e-cigarettes had higher cigarette consumption, current smokers with a past year quit attempt were significantly more likely to use e-cigarettes as compared to those who did not make a past year quit attempt.²⁵

- Although both of these studies have limitations, they suggest that smokers who use e-cigarettes to reduce their consumption of tobacco cigarettes are not doing so successfully; instead of completely replacing tobacco cigarettes, e-cigarettes are an additional source of nicotine. When used in addition to tobacco cigarettes, e-cigarettes are increasing the level of nicotine addiction in users

In addition to increased dependence on nicotine, new data are showing that e-cigarettes have the potential to addict youth to nicotine and increase their uptake of tobacco cigarettes.

- Data from the U.S. National Youth Tobacco Survey (NYTS) indicate that over a quarter million youth who have never smoked tobacco cigarettes used e-cigarettes in 2013, a three-fold increase from 2011.
- Youth who had used e-cigarettes had a higher adjusted odds ratio of having smoking intentions than never users.²⁶

- An additional study using the NYTS data found that among experimenters of tobacco cigarettes, e-cigarette use is associated with established cigarette smoking and lower rates of abstinence from tobacco cigarettes.

These results suggest that e-cigarettes may be contributing to youth nicotine addiction.²⁷ Another study using data from the NYTS analyzed youth perceptions of harm from both e-cigarettes and tobacco cigarettes. The majority of respondents perceived the harmfulness of tobacco cigarettes as dose-dependent and a third of the respondents perceived e-cigarettes as less harmful than conventional tobacco cigarettes.²⁸ The WHO has recognized the dangers posed by e-cigarettes on youth initiation and recommends that countries implement regulations to impede e-cigarette promotion to and uptake by youth and non-smokers.²⁹

Tobacco cessation

Tobacco use continues to be the leading preventable cause of death throughout the world. Currently, over five million deaths annually are attributable to its use worldwide.³⁰ Public health advocates have devoted tremendous resources to the eradication of the tobacco epidemic. The concept of a new technology with the potential to aid in tobacco cessation has been embraced by some in the public health community while others have remained skeptical. This debate continues, with inconclusive evidence on the efficacy of e-cigarettes. Some new studies suggest that e-cigarettes can be one of the tools used for tobacco cessation; however the current science is far from conclusive.

An important study that combined the odds of quitting from 4 longitudinal studies and one cross-sectional study in a random-effects meta-analysis found that e-cigarette use was associated with significantly lower odds of quitting smoking tobacco cigarettes.³¹

There is some evidence to the contrary, though not from population studies. A longitudinal internet survey which assessed the use of e-cigarettes and tobacco among the same cohort over a year found that among these participants, e-cigarettes helped them quit tobacco, reduced the number of cigarettes smoked and prevented a relapse to tobacco.³² Likewise, a large cross-sectional study found that among smokers who attempted to quit without professional support, those who used e-cigarettes were more likely to report continued abstinence than those who used a licensed NRT product or no aid to cessation.³³

Among smokers who are motivated to quit smoking, some studies suggest that e-cigarettes may be helpful. An online survey among current e-cigarette users found that they were used for smoking cessation with a high degree of success.³⁴ Moreover these participants reported reduced cravings for tobacco cigarettes, however, the e-cigarettes tended to be used for a

longer duration than NRT. Another study found that despite lack of conclusive evidence regarding efficacy, smokers treat e-cigarettes as valid cessation aids.³⁵ A third study of callers to six state quitlines showed that those who used e-cigarettes for more than a month in their quit attempt were more likely to be tobacco free than those who used e-cigarettes for less than a month, although quit rates were lower for these two groups than for callers who had never used e-cigarettes.³⁶

Some randomized trials have also been conducted. One conducted among smokers found that e-cigarettes, with or without nicotine, were somewhat effective during a quit attempt; they achieved an abstinence rate equivalent to that of nicotine patches with few side effects.³⁷ In another trial among smokers not intending to quit, e-cigarettes with and without nicotine decreased cigarette consumption without significant side effects.³⁸

Although some physicians have started to recommend e-cigarettes as a cessation aid to their patients, the efficacy of their use has not been established. One study found that two-thirds of surveyed physicians thought e-cigarettes were a helpful cessation aid and one-third had recommended them to their patients³⁹, however, health care providers should advise patients that the products are unregulated, contain potentially toxic chemicals, and haven't been proven for cessation.⁴⁰

- There is no conclusive evidence on the efficacy of e-cigarette use for tobacco cessation
 - A study that combined the odds of quitting from four longitudinal studies and one cross-sectional study in a random-effects meta-analysis found that e-cigarette use was associated with significantly lower odds of quitting smoking tobacco cigarettes
 - On the other hand, some evidence, not from population studies, has indicated that e-cigarettes could be helpful during cessation attempts.
 - Providers should advise patients who want to use these products that they are unregulated, contain potentially toxic chemicals, and are not FDA-approved for cessation.

Harm reduction

Although complete cessation of all nicotine products is the most desirable outcome for all current smokers, reducing the harm caused by nicotine addiction is a goal that has gained traction among the public health community. The American Association of Public Health Physicians has stated that smokers who have been unable to quit using counseling and NRT and

those who do not wish to quit smoking should consider switching to a less hazardous smoke-free product, such as e-cigarettes, snus, dissolvables, or chewing tobacco.⁴¹ Likewise, the WHO has stated that established adult smokers would be exposed to fewer toxins by completely switching from conventional cigarettes or other combusted tobacco products to a regulated e-cigarette.⁴² A recent study which systematically reviewed research articles on the safety of e-cigarettes concluded that although risk is associated with e-cigarette use, the risk is trivial compared with continued smoking of conventional cigarettes.⁴³

E-cigarettes differ from other pharmacological nicotine replacement therapies (NRT) because of their acceptance among smokers.⁴⁴ There is enough evidence to conclude that, unlike other forms of NRT, e-cigarettes are capable of suppressing the urge to smoke as intense cravings may respond better to smoking-related stimuli.⁴⁵ A recent study among asthmatic smokers documented increased pulmonary function by those who quit or greatly reduced their tobacco consumption by switching to e-cigarettes and this success was in part attributed to the e-cigarettes providing a coping mechanism for replacing the smoking gestures.⁴⁶

- E-cigarettes are substantially less harmful than combustible tobacco products

Policy recommendations

Although Alaska currently forbids the sale of any nicotine product to persons under the age of 19, additional policies are needed to prevent the uptake and normalization of these new nicotine products. Building on best practices for tobacco control, the American Heart Association recommends the following policies which address the dangers of e-cigarettes from a public health perspective.⁴⁷

- Include e-cigarettes in clean indoor air regulation.
- Include e-cigarettes in laws prohibiting sales of tobacco to minors, and enforcement of those laws.
- Include e-cigarettes in laws that restrict marketing and advertising.
- Tax e-cigarettes at a rate high enough to discourage youth use, while retaining or increasing differentials with combustible products by increasing taxes on combustibles. Revenue generated from the tax should support tobacco cessation and prevention.
- Support effective FDA regulation that addresses marketing, youth access, labeling, quality control over manufacturing, free sampling, and standards for contaminants.
 - Regulations should allow for quality-controlled products for adults who want to transition from conventional cigarettes to e-cigarettes or to quit or reduce smoking
 - Bottles containing nicotine should have proper warning labels and childproof packaging.
 - Relevant government agency should monitor whether these devices are used for delivery of other drugs or medications.

- Companies should not be allowed to claim that e-cigarettes are a cessation aid unless they are approved by the FDA for that purpose.
- Incorporate screening for e-cigarette use into tobacco screening questions at clinical visits and worksite-community health screenings, and educate clinicians about e-cigarettes.
- Improve and increase surveillance on e-cigarettes use and establish a research agenda to elucidate the public health impact.
- Include e-cigarettes in the definition of tobacco products (or tobacco-derived products) and smoking, not by creating a separate definition for e-cigarettes because a separate definition can create a risk of e-cigarettes being exempted from other tobacco control laws. E-cigarettes could still be treated differently within taxation legislation and regulation.

In addition, local strategies should:

- Ensure that school tobacco policies explicitly include e-cigarettes.

Summary

Strong legislation is needed to prevent youth and non-smokers from the uptake of e-cigarettes which could lead to tobacco initiation. Regulation is needed to prevent the e-cigarette companies from borrowing from the tobacco companies marketing playbook. Marketing should be regulated in the same manner as tobacco with limited media and without the use of celebrities or cartoon characters that target youth.

Although there is some debate over the safety and efficacy of e-cigarettes for smoking cessation, there is currently insufficient evidence that they can be used in this way. Also, there is currently a severe lack of quality control in e-cigarette manufacture along with remaining questions regarding the long-term effects of some of the constituents.

While there is evidence that e-cigarette aerosol does contain toxins, the amounts are many times less than those found in cigarette smoke; e-cigarettes are a less hazardous alternative to cigarettes. Nevertheless, secondhand aerosol poses an unnecessary risk to non-users and the public should be protected from exposure to aerosol.

The comprehensive approach to all aspects of e-cigarette regulation recommended by the American Heart Association builds on best practices for tobacco control and prevention, and represents an important perspective on this emerging issue in tobacco control.

Sources

WHO Framework Convention on Tobacco Control. Electronic nicotine delivery systems. http://apps.who.int/gb/fctc/PDF/cop6/FCTC_COP6_10-en.pdf. Accessed August 28, 2014.

Campaign for Tobacco-Free Kids. Marketing Strategies Entice Kids, Discourage Quitting, Target Minority Communities. http://www.tobaccofreekids.org/press_releases/post/2012_03_05_report. Accessed October 14, 2014.

Bhatnagar A, Whitsel LP, Ribisl KM, et al. Electronic Cigarettes: A policy statement from the American Heart Association. *Circulation*. 2014; 130: 1418-1436. doi: 10.1161/CIR.000000000000107

Grana R, Benowitz N. E-Cigarettes: A Scientific Review. *Circulation*. 2014; 129:172-1986.

Cheng T. Chemical evaluation of electronic cigarettes. *Tobacco Control*. 2014; 23:ii11-ii17. This study was a literature review of published chemical analysis of e-cigarettes cartridges and refill solutions. Additional studies based on scientifically validated aerosol generation methods, aerosol physical property measurement methods and chemical analysis methods would be helpful in generating reliable estimates of chemical quantities and the toxic potential of e-cigarettes.

Goniewicz, ML, Knysak J, Gawron M, et al. Levels of selected carcinogens and toxicants in vapour from electronic cigarettes. *Tobacco Control*. doi: 10.1136/tobaccocontrol-2012-050859; Published Online First: March 6, 2013. This study screened e-cigarette aerosols for content of four groups of potentially toxic and carcinogenic compounds: carbonyls, volatile organic compounds, nitrosamines and heavy metals. Aerosols were generated from 12 brands of e-cigarettes in controlled conditions using a modified smoking machine. The selected toxic compounds were extracted from aerosols and analyzed with chromatographic and spectroscopy methods. Substituting tobacco cigarettes with e-cigarettes may substantially reduce exposure to selected tobacco-specific toxicants.

Centers for Disease Control and Prevention (CDC). Secondhand smoke (SHS) facts. http://www.cdc.gov/tobacco/data_statistics/fact_sheets/secondhand_smoke/general_facts/index.htm. Accessed September 18, 2014.

Schober W, Szendrei K, Matzen W, 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*. 2013, <http://dx.doi.org/10.1016/j.ijheh.2013.11.003>. Accessed August 7, 2014.

Lippi G, Favalaro EJ. E-Cigarettes and Cardiovascular Risk: Beyond Science and Mysticism. *Seminars in Thrombosis & Hemostasis*. 2014; 40:60-65. This literature review accessed the effects of e-cigarette use on the cardiovascular system and concludes that e-cigarettes are safer than traditional tobacco smoke and even other types of smokeless tobacco, adverse effects together with occasional cases of poisoning by device refills have been described.

Czogala, J, Goniewicz ML. Secondhand Exposure to Vapors from Electronic Cigarettes. *Nicotine & Tobacco Research*. 2014; 16(6): 655-662. This study measured selected airborne markers of secondhand exposure: nicotine, aerosol particles (PM_{2.5}), carbon monoxide, and volatile organic compounds in an exposure chamber. E-cigarette aerosol was generated from 3 various brands of e-cigarettes using a smoking machine and controlled exposure conditions. Indoor use of e-cigarettes involuntarily exposes nonusers to nicotine but not to toxic tobacco-specific combustion products.

U.S. Department of Health and Human Services. *Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2012.

Campaign for Tobacco-Free Kids. 7 Ways E-Cigarette Companies Are Copying Big Tobacco's Playbook. http://www.tobaccofreekids.org/tobacco_unfiltered/post/2013_10_02_ecigarettes. Accessed 9/18/2014.

Duke JC, Lee YO, Kim AE, et al. Exposure to electronic cigarette television advertisements among youth and young adults. *Pediatrics*. 2014; 134: e29-e36. E-cigarette companies currently advertise their products to a broad audience that includes 24 million youth. In the absence of evidence-based public health messaging, the current e-cigarette television advertising may be promoting beliefs and behaviors that pose harm to public health. If current trends in e-cigarette TV ads continue, awareness and use of e-cigarettes are likely to increase among youth and young adults.

Emery SL Vera L. Wanna know about vaping? Patterns of message exposure, seeking and sharing information about e-cigarettes across media platforms. *Tobacco Control*. 2014;23:iii17-iii25. This study conducted an online survey of 17,522 US adults in 2013. High levels of awareness about e-cigarettes were indicated (86% aware and 47% heard through media channels). Exposure to e-cigarette related information was associated with tobacco use, age, gender, more education, social media use and time spent online. Gender, high income and using social media were associated with searching for e-cigarette information; lesbian, gay and bisexual and less education were associated with sharing.

Tan AS, Bigman CA. E-Cigarette awareness and perceived harmfulness. *American Journal of Preventive Medicine*. 2014;47(2):141-149. This study was based on 3,630 respondents who completed the Health Information National Trends Survey between October 2012 and January 2013 administered by the National Cancer Institute. Among those who were aware of e-cigarettes, younger, more educated respondents and current smokers (compared with former and non-smokers) were more likely to believe that e-cigarettes were less harmful. Awareness and perceived harm were not associated with smokers' past year quit attempts or intention to quit.

Kim AE, Lee YO. Adult smokers' receptivity to a television advert for electronic nicotine delivery systems. *Tobacco Control*. 2013;0:1-4. A convenience sample of 519 Florida adult smokers were shown an ad for Blu e-cigarettes and subsequently asked questions about the ad. Seeing the ad elicited an urge to smoke (mean 42.1, SD=1.9) and thoughts about smoking cigarettes (75.8%) as well as quitting (74.6%). Prior e-cigarette users were significantly more likely than non-users to report thinking about smoking cigarettes after seeing the ad ($p<0.05$).

Pepper JK, Emery SL. Effects of advertisements on smokers' interest in trying e-cigarettes: the roles of product comparison and visual cues. *Tobacco Control*. 2014;23:iii31-iii36. This study involved 3,253 smokers who had never tried e-cigarettes and were randomly assigned to one of three respondent groups for viewing advertisements: those who saw a person using an e-cigarette; a rechargeable e-cigarette kit; and no e-cigarette. Each ad also had 3 different headlines comparing e-cigarettes to regular cigs: the difference, the similarity, or neither. Ads that emphasized differences between e-cigarettes and regular cigarettes elicited more interest than ads without comparisons ($p<0.01$), primarily due to claims about e-cigarettes' lower cost, greater healthfulness and utility for smoking cessation.

Huang J, Kornfield R. A cross-sectional examination of marketing of electronic cigarettes on Twitter. *Tob Control*. 2014 23: iii26-iii30. During a two month period, 73,672 tweets were collected which were related to e-cigarettes of which 90% were classified as commercial tweets. Commercial tweeting was largely driven by a small group of highly active accounts and 94% included links to websites, many of which sell or promote e-cigarettes.

Zhu S, Sun JY, Bonnevie E, et al. Four hundred and sixty brands of e-cigarettes and counting: implications for product regulation. *Tobacco Control*. 2014;23:iii3-iii9. Comprehensive internet searches of English-language websites from May-August 2012 and December 2013-January 2014 identified brands, models, flavors, nicotine strengths and product claims of e-cigarettes. In the 17 months between the searches, there was a net increase of 10.5 brands and 242 new flavors per month. Older brands were significantly more likely to claim that they were healthier, cheaper, and good substitutes to regular cigarettes. Newer brands emphasized flavors and were less likely to compare themselves to tobacco cigarettes.

Richardson A, Pearson J. Prevalence, harm perceptions, and reasons for using noncombustible tobacco products among current and former smokers. *American Journal of Public Health*. 2014; 104(8): 1437-1444. This study addressed awareness of, prevalence of, purchase of, harm perceptions of, and reasons for using noncombustible tobacco products among 1,487 current and former smokers. Noncombustible tobacco use was associated with being male, non-Hispanic white, younger, and more nicotine dependent. Only snus was associated with a higher likelihood of making a quit attempt.

Lee S, Grana RA. Electronic cigarette use among Korean adolescents: A cross-sectional study of market penetration, dual use, and relationship to quit attempts and former smoking. *Journal of Adolescent Health*. 2014;54:684-690. This study analyzed a 2011 web-based survey of 75,643 South Korean youth aged 13-18. Among current cigarette smokers, those who smoked more frequently were more likely to be current e-cigarette users. The odds of being an e-cigarette user were 1.58 times (95% confidence interval, 1.39-1.79) higher among students who had made an attempt to quit than for those who had not. It was rare for students no longer using cigarettes to be among current e-cigarette users (odds ratio, .10 CI: .09-.12).

Bunnell RE, Agaku IT, Arrazola RA, et al. Intentions to smoke cigarettes among never-smoking U.S. middle and high school electronic cigarette users, National Youth Tobacco Survey, 2011-2013. *Nicotine Tob Res*. 2014 doi: 10.1093/ntr/ntu166 first published online: August 20, 2014.

Dutra LM, Glantz SA. Electronic Cigarettes and Conventional Cigarette Use Among US Adolescents: A Cross-sectional Study. *JAMA Pediatrics*. 2014; 168(7):610-617. This is a cross sectional study of US middle and high school students who completed the 2011 and 2012 National Youth Tobacco Survey (n=17,353 in 2011 and 22,529 in 2012). Use of e-cigarettes was associated with higher odds of ever or current cigarette smoking, higher odds of established smoking, higher odds of planning to quit smoking among current smokers, and, among experimenters, lower odds of abstinence from conventional cigarettes.

Ambrose BK, Rostron BL, Johnson SE, et al. Perceptions of the Relative Harm of Cigarettes and E-cigarettes Among U.S. Youth. *American Journal of Preventive Medicine*. 2014; 47(2S1):S53-S60. This study used data from the 2012 National Youth Tobacco Survey (N=24,658) to identify patterns of cigarette harm perceptions among youth. Multinomial logistic regression was conducted to identify associations between demographic and tobacco use characteristics and cigarette harm perceptions patterns. Logistic regression was conducted to examine the relationship between cigarette harm perceptions and the perception of e-cigarettes as less harmful than cigarettes for current, ever, and never cigarette smokers. Regardless of cigarette smoking status, ever users of e-cigarettes and those with "dose-dependent" cigarette harm perceptions consistently were more likely to perceive e-cigarettes as less harmful than conventional cigarettes.

Centers for Disease Control and Prevention (CDC). Fast Facts.

http://www.cdc.gov/tobacco/data_statistics/fact_sheets/fast_facts/. Accessed 9/18/2014.

Etter J, Bullen C. A longitudinal study of electronic cigarette users. *Addictive Behaviors*. 2014; 39(2): 497-494. This was a longitudinal internet survey from 2011-2013 which assessed use of e-cigarettes and tobacco among the same cohort at baseline, after one month (n=477), and one year (n=367). Most participants were former smokers (72%) and 76% were using e-cigarettes daily. Almost all the daily vapers at baseline were still vaping daily after one month (98%) and one year (89%). Among former smokers who were vaping daily at baseline, 6% had relapsed to smoking after one month and also 6% after one year. Among dual users, 22% had stopped smoking after one month and 46% after one year. In dual users who were still smoking at follow-up, cigarette consumption decreased by 5.3 cig/day after one month, but remained unchanged between baseline and the year follow-up.

Brown J, Beard E. Real-world effectiveness of e-cigarettes when used to aid smoking cessation: a cross-sectional population study. *Addiction*. 2014;109(9): 1531-40. This study was a large cross-sectional survey of a representative sample of the English population. It included 5,863 adults who had smoked within the past 12 months and made at least one quit attempt during that period with either an e-cigarette only (n=464), NRT only (n=1,922) or no aid (n=3,477). Abstinence was self-reported among the participants. The adjusted odds of non-smoking in users of e-cigarettes were 1.63 (95% CI 1.17-2.27) times higher compared with users of NRT and 1.61 (95% CI 1.19-2.18) times higher compared with those using no aid.

Dawkins L, Turner J. Vaping profiles and preferences: an online survey of electronic cigarette users. *Addiction*. 2013;108: 1115-1125. This study consisted of 1,347 online participants of whom 74% reported not smoking for at least a few weeks since using the e-cigarette and 70% reported reduced urge to smoke. Mean duration of use was 10 months. E-cigarettes were considered to be satisfying to use; elicit few side effects; be healthier than smoking; improve cough/breathing; and be associated with low levels of craving. Among ex-smokers, "time to first vape" was significantly longer than "time to first cigarette" suggesting a lower level of dependence to e-cigarettes.

Pokhrel P, Fagan P. Smokers who try e-cigarettes to quit smoking: findings from a multiethnic study in Hawaii. *American Journal of Public Health*. 2013;103(9): e57-e62. This was a cross-sectional study of 1,567 adult daily smokers in Hawaii who were surveyed from 2010-2012. 13% of respondents reported having ever used e-cigarettes to quit smoking and those who had used them reported higher motivation to quit, higher quitting self-efficacy, and longer recent quit duration than did other smokers.

Vickerman KA, Carpenter KM. Use of electronic cigarettes among state tobacco cessation quitline callers. *Nicotine & Tobacco Research*, 2013;15(10): 1787-1791. This study collected data from 2,758 callers to 6 state tobacco quitlines 7 months after they received intervention from the quitline program. 30.9% of respondents reported ever using or trying e-cigarettes; most (61.7%) used them for less than a month. Reasons for use were to help quit tobacco (51.3%) or to replace other tobacco (15.2%). The respondent quit rates after 30 days were 31.3% for non-e-cigarette users, 21.7% for a month or longer e-cigarette users and 16.6% for less than a month e-cigarette users, these percents were all significantly different.

Bullen C, Howe C, Laugesen M, et al. Electronic cigarettes for smoking cessation: a randomised controlled trial. *Lancet*. 2013; 382: 1629-37. 657 Adult smokers who wanted to quit were randomized into three groups: nicotine e-cigarettes, patches, and placebo e-cigarettes. At 6 months verified abstinence was 7.3% for nicotine e-cigarettes, 5.8% for patches and 4.1% for placebo e-cigarettes. Statistical differences couldn't be calculated due to small numbers. There was no correlation between adverse effects and study products.

Caponnetto P, Campagna D, Cibella F, et al. Efficiency and safety of an eElectronic cigAreTte (ECLAT) as tobacco cigarettes substitute: A prospective 12-month randomized control design study. *PLoS ONE*. 2013;8(6): e66317. This study was a 12-month randomized, controlled trial that evaluated smoking reduction/abstinence in 300 smokers not intending to quit using two different strengths of a popular e-cigarette model and a non-nicotine e-cigarette. Declines in cig/day use and exhaled carbon monoxide levels were observed at each study visit in all three study groups ($p < 0.001$ vs. baseline) with no consistent differences among study groups.

Kandra KL, Ranney LM. Physicians' attitudes and use of e-cigarettes as cessation devices, North Carolina, 2013. *PLoS ONE*. 2014;9(7):e103462. This study surveyed 787 North Carolina physicians via an email survey. A total of 413 respondents opened the email and 128 responded to the survey. Physicians were more likely to recommend e-cigarettes when their patients asked about them or when the physician believed e-cigarettes were safer than smoking tobacco cigarettes.

American Association of Public Health Physicians. Principles to Guide AAPHP Tobacco Policy. <http://www.aaphp.org/tobacco>. Accessed September 18, 2014.

Farsalinos KE, Polosa R. Safety evaluation and risk assessment of electronic cigarettes as tobacco cigarette substitutes: a systematic review. *Therapeutic Advances in Drug Safety*. 2014; 5(2): 67-86. This study was a literature review of 114 studies on the chemical analyses of e-cigarettes.

Nitzkin JL. The case in favor of e-cigarettes for tobacco harm reduction. *Int. J. Environ. Res. Public Health*. 2014;11: 6459-6471. This paper makes the case for tobacco harm reduction

(THR) with e-cigarettes as a prominent THR modality being the only feasible policy option with the potential to substantially reduce tobacco-attributable illness and death in the US over the next twenty years, and do so without adversely effecting initiation or quit rates.

Cahn Z, Siegel M. Electronic cigarettes as a harm reduction strategy for tobacco control: A step forward or a repeat of past mistakes?. *Journal of Public Health Policy*. 2011;32(1):16-31. This study reviewed the existing evidence on the safety and efficacy of e-cigarettes and how these products relate to the tobacco harm reduction debate. E-cigarettes show tremendous promise in the fight against tobacco-related morbidity and mortality.

Polosa R, Morjaria J, Caponnetto P, et al. Effect of smoking abstinence and reduction in asthmatic smokers switching to electronic cigarettes: Evidence for harm reversal. *Int. J. Environ. Res. Public Health*. 2014;11:4965-4977. This study reports on subjective and objective asthma parameters in asthmatic smokers who quit or reduced their tobacco consumption by switching to e-cigarettes. There were significant improvements in asthma control and airway hyper-responsiveness. Positive outcomes were noted in single and dual users.

¹ WHO

² See: http://www.tobaccofreekids.org/press_releases/post/2012_03_05_report last accessed 10/14/2014

³ The American Heart Association – Bhatnagar A, Whitsel L, Ribisl K, et al. Electronic cigarettes: A policy statement from the American Heart Association. *Circulation* 2014. Available online at: <http://circ.ahajournals.org/content/130/16/1418.full>

American Heart Association Policy statement, see: <http://circ.ahajournals.org/content/130/16/1418.full> last accessed 10/14/2014

⁴ Grana

⁵ Cheng

⁶ Goniewicz

⁷ Cheng

⁸ WHO

⁹ CDC, http://www.cdc.gov/tobacco/data_statistics/fact_sheets/secondhand_smoke/general_facts/index.htm

¹⁰ Schober

¹¹ Lippi

¹² Czogala

¹³ U.S. Department of Health and Human Services. Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2012.

¹⁴ See: http://www.tobaccofreekids.org/tobacco_unfiltered/post/2013_10_02_ecigarettes last accessed 9/18/2014

¹⁵ Duke

¹⁶ Emery

¹⁷ Tan

¹⁸ Tan

¹⁹ Emery

²⁰ Kim

²¹ Pepper

²² Huang

²³ Zhu

²⁴ Richardson

²⁵ Lee

²⁶ Bunnell

²⁷ Dutra

²⁸ Ambrose

²⁹ WHO

³⁰ CDC (http://www.cdc.gov/tobacco/data_statistics/fact_sheets/fast_facts/) last accessed 9/18/2014.

³¹ Grana

³² Etter J and Bullen C

³³ Brown 2014

³⁴ Dawkins

³⁵ Pokhrel

³⁶ Vickerman

³⁷ Bullen C

³⁸ Caponnetto 2013

³⁹ Kandra 2014

⁴⁰ Grana

⁴¹ American Association of Public Health Physicians, "Principles to Guide AAPHP Tobacco Policy", <http://www.aaphp.org/tobacco> last accessed 9/18/2014.

⁴² WHO

⁴³ Farsalinos and Polosa

⁴⁴ Nitzkin

⁴⁵ Cahn and Siegel

⁴⁶ Polosa

⁴⁷ The American Heart Association – Bhatnagar A, Whitsel L, Ribisl K, et al. Electronic cigarettes: A policy statement from the American Heart Association. Circulation 2014. Available online at: <http://circ.ahajournals.org/content/130/16/1418.full>