



E-Cigarette Use - Did we Learn from our Mistakes?

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Abstract

Background: The prevalence of electronic cigarette use in the adolescent population has increased quickly over the past few years. Complexity and customizability of the electronic cigarettes, and now vaporizers, has mirrored the increase in demand. Most concerning is the pattern of e-cigarette use and pro-e-cigarette advertisement, which resembles those of traditional cigarettes in the early 20th century. Unfortunately, data on e-cigarettes is minimal and equivocal at best.

Materials and Methods: A review of the English literature was performed using Pubmed/MEDLINE for demographics, epidemiology, and studies that focused on the electronic cigarette use, particularly in the adolescent population.

Results: E-cigarette use has increased drastically over the past four years, as have pro-e-cigarette advertisements. Unfortunately, pro-e-cigarette advertisements are unopposed, and legislature has not caught up with the increasing prevalence of e-cigarette use. Because data are lacking, only preliminary warnings can be issued; however, given the concerning similarity between e-cigarette and traditional cigarette trends, prevention is critical, particularly in the adolescent population.

Conclusion: As the popularity of e-cigarettes increases, data regarding long-term use will naturally lag behind. Increasing awareness of this bothersome trend in order to concentrate a healthcare, legislative, and social framework to combat the use of e-cigarettes before definitive data are gathered is necessary and may portend a great benefit to nicotine-associated comorbidities in the near future.

Keywords: Head and neck cancer; E-cigarettes; Vaping; Adolescent; Survival; Prevention

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Introduction

Head and Neck Cancer (HNCa), defined as cancer of the oral cavity, pharynx, larynx, paranasal sinuses and nasal cavity, and the salivary glands, is the ninth most common cancer in the United States and the fourteenth most common cause of death [1]. HNCa will account for an estimated 55,070 new cancers in the United States in 2014, accounting for 3.3% of all cancers [1]. Although HNCa accounts for a small percentage of all cancers, morbidity and mortality are high and inappropriate treatment can be devastating. Of particular importance is the close association of head and neck cancer with tobacco use, in addition to lung and esophageal cancers [2]. Smoking is associated with mortality in 87.2, 82.0, 73.1, and 71.0% patients with lung, laryngeal, oral cavity, and esophageal cancer, respectively. However, the incidence of HNCa has decreased over the past two decades [3-5]. Currently, rates of HNCa have plateaued, mirroring the decreasing rate of tobacco use [6].

Head and neck cancer is the end result of multiple mutations, causing normal tissue to expand uncontrolled and invade surrounding tissues. Often, many mutations are required, and genetic and epigenetic factors may predispose a specific type of tissue to malignant transformation [7]. Tobacco and alcohol play the greatest role in head and neck carcinogenesis. Exposure to the upper aerodigestive tract to tobacco and alcohol likely causes premalignant changes in cells, and when paired with inhibition of tumor suppressor genes such as Tp53 enhances the malignant transformation of head and neck mucosa [8,9].

Unfortunately, the head and neck mucosa is constantly exposed to unknown substances that may cause premalignant changes. Traditional cigarettes were consumed for decades before the carcinogenic effects of tobacco exposure to the head and neck were elucidated, established, and dispersed to the population. Even after the data clearly indicated the harm of tobacco products, many years passed before tobacco use was considered a significant contributor to head and neck cancer. In

the same manner, electronic cigarettes are readily consumed without regard for various substances contained within electronic cigarettes, and long-term results cannot be predicted without exposure over an extended period of time.

As electronic cigarette and vaporizer use increases, one cannot help but notice a striking resemblance to the pattern seen with traditional cigarettes nearly half a century ago. Of particular concern is the growing incidence of electronic vaporizer use in the adolescent population. Advertisements have increased and run unopposed in a generally impressionable age group, while long-term effects of e-cigarette use remains inconclusive. In an effort to stimulate awareness of e-cigarette use in the adolescent population, the below review was performed.

Materials and Methods

A review of English literature was performed using PubMed/MEDLINE for electronic cigarettes, traditional cigarettes, and vaporizers, particularly focusing on the adolescent population. Keywords used include a combination of the following: “electronic cigarette,” “traditional cigarette,” “adolescent” “epidemiology,” “vaporizer,” “vaping,” “advertisements,” and “e-cigs” Reference searches were performed manually for all retrieved articles to ensure that all available studies and data were reviewed.

Anatomy of electronic cigarette

The anatomy of an electronic cigarette begins with cartridge holding nicotine dissolved in the select manufacturer’s solvent of choice, often propylene glycol or glycerin. The cartridge abuts a heating mechanism that can vaporize the active ingredient within the cartridge, which, in the case of e-cigarettes, is nicotine. When the user takes a drag of the e-cigarette, the microprocessor recognizes the pressure gradient formed and ignites the heating mechanism to vaporize the cartridge contents. Attached to the microprocessor is often a battery, either disposable or rechargeable, that powers the unit.

A new generation of electronic devices has emerged recently, an iteration of electronic cigarettes, called vaporizers, or “clearomizers.” These new devices further compartmentalize the device to include a clear cartridge housing the desired substance to be vaporized. The cartridge can be dismantled from the mouthpiece and separated from the microprocessor and battery unit and can be replaced readily. This has allowed for a significant increase in customizability of vaporizers.

Prevalence of e-cigarette use in the adolescent population

Prevalence of e-cigarette use amongst adolescents has unfortunately increased over the past few years. In 2011, 3.1-3.3% of U.S. adolescents had ever used e-cigarettes, while 1.1% were current e-cigarette users [10,11]. In 2012, the rates doubled to 6.5-6.8% and 2.0-2.1% respectively. The most recent data show 10.3% of a subset of U.S. adolescents had ever used e-cigarettes [12]. Internationally, prevalence is highly variable, with 0.5% of Korean middle and high school students reporting ever using e-cigarettes compared to 23.5% in Poland [13,14]. Of the previously reported studies, 61.2% (57.2-64.5%) of ever e-cigarette users and 65.1% (60.8-72.7%) of current e-cigarette users were male. Another study demonstrated an increase in 30-day use amongst middle and high school students from 1% up to 9% amongst 8th graders, 16% amongst 10th graders, and 17% amongst 12th graders [15].

E-cigarette associated behaviors

Most concerning are tobacco associated behaviors in adolescents who use e-cigarettes. In a study performed in 2011, 75% of current e-cig users were also traditional cigarette smokers [16]. Of those who use e-cigarettes, 9.2% were never traditional cigarette smokers [16]. When broadening the scope of concurrent use of alcohol, marijuana, cigars, and other smokeless tobacco products, there was no statistically significant difference in use amongst e-cigarette users and traditional cigarette users [16]. Not surprisingly, having a parent or partner who smoked traditional cigarettes was a significant predictor of ever or current e-cigarette use.

E-cigarette advertisement

Advertisements for e-cigarettes have gone unregulated and unopposed. Attempts to combat advertisements have by-and-large been unfruitful. The four television channels with the highest rate of e-cigarette advertisement are Country Music Television (Nashville, TN), Comedy Central (New York, NY), AMC (New York, NY), and WGN America (Chicago, IL) [17]. Youth exposure to e-cigarette advertisements has increased rapidly, as demonstrated by an increase of 256% from 2011 to 2013 [17]. Target rating points (TRPs), as monitored by the Nielsen Company (New York, NY), can be used as a surrogate for television advertising. The CDC recommends 800 quarterly TRPs for anti-tobacco mass-media campaigns, or sustained low levels in the 300s [17]. Unfortunately, pro-electronic cigarette TRPs have recently peaked at 347 [17]. However, there are no anti-electronic cigarette smoking campaigns and the current TRP peak for e-cigarette campaigns continues to run unopposed.

Organic effects of e-cigarettes

Unfortunately the question of whether e-cigarettes and vaporizers cause harm remains unanswered, without abundant supportive data. There are many contaminants found in electronic cigarettes that are also found in traditional cigarettes, such as polycyclic aromatic hydrocarbons, tobacco-specific nitrosamines, and volatile organic compounds, although to a lesser degree [18]. Some argue that this may decrease the harmful effects that are associated with the use of traditional cigarettes. But data remains scant regarding the solvent that is often used in electronic cigarette cartridges, such as propylene glycol or glycerin. Similar to the early 20th century, when traditional cigarettes were consumed without regard for their contents and before data could support the harmful effects of tobacco products, we see that e-cigarette users are exposed to compounds with unknown long-term consequences. In addition, further customization of electronic cigarettes, such as the advent of the exchangeable clearomizer, can introduce user added contaminants that cannot be studied and that may cause significant harm to the user. Unfortunately, the harmful effects of traditional cigarettes were discovered nearly a half-century after they had become popular and the same may be true of electronic cigarettes and vaporizers. Combating damage that had already been done, both culturally and medically, continues to burden the medical professionals to this day.

There have been some *in vitro* studies comparing exposure to e-cigarettes to that of traditional cigarettes. One preliminary study demonstrated that high nicotine e-cigarette conditioned media induced a gene expression pattern similar to that seen when the same cell cultures were exposed to traditional cigarette conditioned media [19]. Another study demonstrated an equivalent or greater toxicity to immune regulatory cells, such as dendritic cells, when exposed to extracts from presumed “reduced harm” cigarettes [20].

These immune regulatory cells are identified in the pathogenesis of smoking-induced disease, such as chronic obstructive pulmonary disease [21].

Conclusion

Exposure to e-cigarettes in the adolescent population is a concerning trend that may harbor long-term morbidity. Prevalence of e-cigarette and vaping use continues to increase in the adolescent population, as do advertisement campaigns, which have gone unopposed. As the popularity of e-cigarettes increases, data regarding long-term use will naturally lag behind. Although preliminary studies are equivocal, it is difficult to ignore the similarity between current e-cigarette trends and historical traditional cigarette trends. Increasing awareness of this bothersome trend in order to concentrate a healthcare, legislative, and social framework to combat the use of e-cigarettes before definitive data are gathered is necessary and may portend a great benefit to nicotine-associated comorbidities in the near future.

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