



Electronic Cigarettes—A Narrative Review for Clinicians

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ABSTRACT

Electronic cigarettes (e-cigarettes) were introduced into the US market in 2007 and have quickly become a popular source of nicotine for many patients. They are designed to simulate smoking by heating a nicotine-containing solution producing an aerosol that the user inhales. The short- and long-term effects of e-cigarette use are still unclear, but their use is increasing. Some acute effects of e-cigarettes on heart rate, blood pressure, and airway resistance are reported. Although there are some reports of improved cessation in a subset of users, there are also studies reporting decreased cessation in dual users of regular and e-cigarettes. Additionally, there is no current regulation of these devices, and this allows virtually anyone with a form of online payment to obtain them. © 2015 Elsevier Inc. All rights reserved. • *The American Journal of Medicine* (2015) 128, 674-681

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Electronic cigarettes (e-cigarettes) are the most common type of a category of products called electronic nicotine delivery systems. E-cigarettes are relatively new products designed to simulate smoking by heating a solution that typically includes nicotine, flavorings, and a delivery system like propylene glycol or glycerin, or both. Other examples of these devices include cigars, pipes, and hookah-like products.^{1,2}

The first commercialized e-cigarette product was invented in 2003 and officially entered the US marketplace in 2007.^{3,4} These products have a particular nomenclature related to their use, and clinicians should know these terms to have productive conversations with patients (**Table 1**).^{2,4,5}

COMPOSITION, MARKETING, SALES DATA, AND RESPONSE FROM THE TOBACCO INDUSTRY

Construction

Electronic cigarettes have four parts: the battery, the heating element, the vaporizing chamber, and the solution cartridge (**Figure**).

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The battery is the power supply that provides the electrical current to the heating element needed to reach temperatures high enough to aerosolize the solution. This is usually a cylindrically shaped lithium ion rechargeable battery. The size and shape of the battery contributes significantly to the overall size and convenience of the e-cigarette; smaller devices allow easier transportability but usually need more frequent recharging. The lithium ion batteries provide higher voltages (>3 volts), necessary for producing the aerosol in the desired amounts, than traditional batteries (1.5 volts). There have been reports of these batteries overheating and exploding after being charged inappropriately or during an attempt to “light” the cigarette with a flame by mistake.⁶

The heating element provides the necessary heat for aerosolization of the nicotine solution. Many e-cigarette models include a voltage potentiometer that allows the user to select the amount of aerosol produced and nicotine concentration. A chamber houses the heating element and holds the aerosol until the user is ready to draw or inhale.

The solution cartridge contains the flavored nicotine solution (see **Table 1**) for aerosolization. This liquid includes a vehicle solution (propylene glycol, low molecular propylene glycol, or vegetable glycerin), artificial flavorings, and variable concentrations of nicotine. This may be refillable by the user or exchanged for prefilled cartridges. The number of choices in the composition of

e-cigarette solutions is increasing, and there is significant variability between the labeled content and the actual content and concentrations.⁴

Styles

E-cigarettes are available in a number of models and styles. Many take the appearance of traditional cigarettes—a “filter” at the bottom with white tubing and a red or orange glow tip. The “filter” is usually the cartomizer exterior (cartomizer = fusion of the cartridge and atomizer) and the “tobacco” part is usually the battery exterior. Others do not mimic the look of cigarettes, because some customers want to easily demonstrate they are not truly smoking in a nonsmoking area. Some companies have created an identity through a distinctive design that promotes brand recognition, such as the Blu eCig electronic cigarettes (Lorillard, Walpole, MA). Companies are also introducing customizable devices that allow multiple looks by using exchangeable exteriors.

Operation

The type of battery—automatic or manual—has an important role in how the e-cigarette is used. With an automatic battery, the user simply draws on the device like a traditional cigarette. With a manual battery, a button must be pressed to

activate the device and produce heating. The automatic type behaves more like traditional cigarettes.

Many e-cigarette models include a voltage potentiometer that allows the user to select the amount of aerosol produced, thereby selecting the amount of nicotine to be inhaled.⁷ Other operational details depend on the e-cigarette’s intended use. There are disposable models intended for one-time use. Others are intended for multiple uses and must be refilled either manually or with prefilled cartridges, and regular cleaning is necessary.

Marketing and Sales

In April 2014, the US Food and Drug Administration (FDA) announced plans to nationally regulate e-cigarettes like tobacco products.⁸ This includes restricted sales to minors and restricted advertising. Currently, the FDA’s Center for Tobacco Products is establishing a public docket in conjunction with a public workshop to gather information to advance the proposed regulation.⁹ Submission of comments ends in April 2015. Although some e-cigarette companies have announced their support of these proposed regulations, others are

less enthusiastic. Until the regulations are finalized, the current state of the market is completely unregulated. The devices and the “e-juice” are available online to anyone with a means of online payment. Television and print ads are

CLINICAL SIGNIFICANCE

- E-cigarettes have become a popular source of nicotine.
- E-cigarettes have acute physiological effects, including increases in blood pressure, heart rate, and airway resistance.
- The long-term effects of e-cigarettes are unknown.
- There is insufficient evidence to recommend e-cigarettes for smoking cessation, although some reports of improved cessation exist. Dual use with regular cigarettes has been associated with decreased smoking cessation.
- E-cigarettes should not be viewed as “safe” as they can cause acute lung disease, atrial fibrillation, and nicotine poisoning.

Table 1 Electronic Cigarette Nomenclature

Name	Definition	Other Names
Electronic cigarette	The device designed to produce aerosol by heating the solution in the cartridge.	E-cig, smokeless cigarette, cig-a-like, vaporette, technofogger, personal vaporizer, vaping device, vapor pen, e-hookah.
Electronic cigarette use	The act of inhaling the heated aerosolized solution and subsequently exhaling is similar to smoking a regular cigarette.	Verbalized as “vaping.” An e-cigarette user may be described as a “vaper.” These terms are actually misnomers as the aerosol produced is technically not a vapor. The aerosol produced by e-cigarettes has a particulate phase, not just a gas phase like a vapor. ⁵
Electronic cigarette solution	The solution usually contains a mixture of propylene glycol or vegetable glycerin or both, with or without nicotine, and flavorings.	E-juice, e-liquid, juice, vapor juice, smoke juice
Hot cigarette Mods	A regular tobacco cigarette Modifications made to an e-cigarette used to produce higher amounts of aerosol	Cloud chaser, cloud chasing

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