



ELECTRONIC CIGARETTES: EFFECT ON HEALTH & ITS PREVENTION

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ABSTRACT

Electronic cigarettes (ECs) are devices that are used recreationally or as smoking cessation tools, and have become increasingly popular in recent years. A heating element in the EC aerosolizes a solution of propylene glycol, glycerol, nicotine (optional) and flavoring agent (optional). These compounds are generally harmless on their own. However, upon heating they produce various carcinogens and irritants. Concentrations of these toxicants vary significantly depending on the type of EC device, the sort of EC liquid and therefore the smoking behaviour of the user. Exposure to these vapours can cause inflammation and oxidative damage to in vitro and in vivo cells. EC aerosol can also potentially affect organ systems and especially cardiovascular and lung function. EC use causes acute effects on health but not as severe as those of conventional cigarettes (CCs). These devices could, therefore, be of use for smokers of CCs wishing to quit. However, as EC aerosol introduces new toxicants not found in CCs, long-term studies are needed to investigate possible chronic effects associated with EC use.

KEYWORDS: Electronic cigarette, cessation, safety, effectiveness.

INTRODUCTION

Electronic cigarettes (e-cigarettes) have been increasingly popular among youth and adults.^[1] E-cigarettes purportedly don't involve tobacco combustion; rather, nicotine and therefore the other components are aerosolized prior to inhalation. While the lack of combustion likely reduces toxicant exposure for e-cigarette users as compared to traditional cigarettes. Users and others may experience second hand or third hand exposures through direct physical contact with product components or inhaling secondhand aerosol.

ECs have existed for a long period of time, as they were first patented in 1965 by HA Gilbert as a device that looked like a conventional cigarette (CC) but did not contain the carcinogens of tobacco, designed to replace the use of CCs. The idea of the EC did not gain momentum until a second patent of the modern EC was

taken out by H Lik in 2003.^[2] Unlike the 1965 patent, this device was marketed as a smoking cessation device as it contained nicotine to suppress the physiological desire to smoke. Similar to the 1965 patent, this device is free of the carcinogenic tar and carbon monoxide that exists in CCs.^[2]

ECs are electronic nicotine delivery devices that are shaped to look like a CC and are powered by a lithium battery.^[3] Specifically, ECs are made of a plastic tube, an electronic heating element, a liquid cartridge and a battery (Fig. 1). The battery powers the heating element that heats and vaporizes the liquid in the cartridge, which the user, termed "vaper", then inhales. Depending on the type of device, the voltage and power may vary, changing the amount of vapour produced per puff as well as the inhalation toxicity of aerosolants.^[2]



Fig. 1: Structure of an electronic cigarette (EC).

The main components of EC liquids are propylene glycol, which creates the artificial smoke of the EC and glycerol (i.e. glycerin), which contains optional nicotine and flavouring agents. Glycerol and propylene glycol are classified by the Food and Drug Administration (FDA) with the label “generally recognized as safe” for ingestion. However, once heated, there is no indication as to the safety of the inhalation of these compounds or any compounds that might be produced by heat-induced degradation of these compounds. ECs also run the risk of containing toxic impurities like heavy metals or tobacco-specific nitrosamines (TSNAs).

With regard to their design, there are 4 generations of devices currently on the market. The first generation e-cigarettes are the “ciga-like” devices, which are utilized mainly by new e-cigarette users; they are constructed of a cartomizer (cartridge and an atomizer) with a low-voltage battery (3.7 V). Second-generation e-cigarettes are primarily used by more-experienced users and are bigger in size with a refillable tank (unlike first-generation devices). Their battery voltage is adjustable, allowing users to use low or high voltage (3–6 V) during vaping. The third-generation devices are also known as mods and have the largest size batteries, with voltages up to 8 V. Finally, the fourth and most up-to-date generation includes Sub ohm tanks (devices whose atomizer coils have a resistance of but 1 ohm) and temperature control devices, which permit for temperature modulation during vaping. With these devices, the “vaper” can inhale huge puff volumes, resulting in extremely high e-liquid consumption per puff.^[4]

Potential Effects of e-Cigarettes on Biological Systems

System	Effects of e-Cigarettes
Pulmonary system	Upper and lower respiratory tract irritation Bronchitis, cough and emphysema
Immune system	Inflammation induction Reduce immune efficiency
Central nervous system	Behavioral changes Memory impairment (animal models) Tremor and muscle spasms
Miscellaneous	Ocular irritation Contact dermatitis and burns

Nausea and vomiting. Throat and mouth irritation.
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Physiological effects observed in clinical studies

Nine studies evaluated the physiological effects of e-cigarette use. E-cigarettes are frequently marketed as ‘safe’ products. However, while the inhaled compounds related to E-cigarettes could also be fewer and fewer toxic than those from traditional cigarettes, data to determine whether e-cigarette use as an entire is less harmful to the individual user than traditional cigarettes aren’t conclusive.

Studies reviewed noted the subsequent observed physiologic effects related to acute exposure to e-cigarettes or e-cigarette aerosols

- Mouth and throat irritation and dry cough at initial use, though complaints decreased with continuing use.^[5]
- No change in heart rate, carbon monoxide (CO) level or plasma nicotine level.^[6]
- Decrease in fractional exhaled nitric oxide (FeNO), increase in respiratory impedance and respiratory flow resistance similar to cigarette use.^[7]
- No change in complete blood count (CBC) indices.^[8]
- No change in lung function.^[9]
- No change in cardiac function as measured with echocardiogram.^[10]
- No increase in inflammatory markers.^[11]

Preventive Policies

To minimize deleterious health effects, we recommend the following measures:

- Prohibit the use of e-cigarettes anywhere that use of conventional cigarettes is prohibited, including in smokefree homes.
- Tax e-cigarettes at levels comparable to cigarettes.
- Include e-cigarettes in public education campaigns, particularly communicating the facts that they are not “harmless water vapor,” do pollute the air, are a gateway to conventional cigarettes, and are increasingly sold by the same multinational companies that sell conventional cigarettes.

- Prohibit the sale of e-cigarettes to anyone who cannot legally buy cigarettes or in any venues where the sale of conventional cigarettes is prohibited.
- Establish a minimum purchase age of 21.
- Subject e-cigarettes to the same marketing restrictions that apply to conventional cigarettes (including no television, radio, or outdoor advertising).
- Prohibit cobranding of e-cigarettes with cigarettes or marketing in a way that promotes dual use.
- Prohibit flavored e-cigarettes, particularly menthol, candy, fruit and alcohol flavors.
- Prohibit claims that e-cigarettes are effective smoking cessation aids until e-cigarette companies provide sufficient evidence that, as actually used in the real world, e-cigarettes are effective for smoking cessation.
- Prohibit any health claims about e-cigarette products until and unless they are authorized by the appropriate regulatory agencies (the FDA in the United States) using scientific and regulatory standards that account for dual use and effects of e-cigarette use on depressing smoking cessation.
- Establish quality standards for ingredients and functioning of e-cigarette devices.
- Implementing these policies would reduce the likelihood that e-cigarettes will continue to expand and extend the tobacco epidemic.

CONCLUSION

ECs are becoming an increasingly popular alternative to smoking CCs, which are perceived as more toxic. Some recent research even suggests some beneficial effects of switching from CCs to EC products, like for asthma patients. However, it is clear that EC use is not without associated risks. Acute use of these devices has been shown to lead to lung inflammation, which could cause or progress conditions such as COPD, oxidative damage, potential cardiac and pulmonary function impairment, potential behavioural modification, immunological effects and more.

Research is still very recent and the exposure time in the majority of the papers is short (a few days), as researchers tend to focus on the acute effects of EC use. Therefore, we need to interpret current research with care as we still poorly understand how such acute effects translate to disease risk. Users should, therefore use these devices with caution, especially given the lack of long-term studies of the health effects of EC use. However, evidence to date suggests that, when used properly, these devices can represent an effective replacement for CC use, at least in the short term, given the various health risks associated with CC smoke.

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