



Patients with lung cancer: Are electronic cigarettes harmful or useful?



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ABSTRACT

E-cigarettes remain controversial because the scientific evidence of short term and long term effects on tolerance and the health value of a switch from tobacco to e-cigarettes is contested and controversial. Nevertheless the quality of e-cigarettes and e-liquids has improved. The main ingredients, propylene glycol, vegetable glycerine and nicotine are pharmaceutical-grade quality in most e-liquids. Flavors are almost all food grade. The high quality of ingredients has decreased the presence of impurities in e-liquids.

The emissions of e-cigarettes do not contain solid particles or carbon monoxide. Nitrosamine content is at least one hundred times lower than in tobacco smoke. E-cigarette emissions in normal use do not contain any harmful constituents at significant levels except nicotine. UK public health authorities have stated that e-cigarette use is likely to be at least 95% less toxic than cigarette use.

There are benefits from having a well-regulated legal market. In countries where e-liquid containing nicotine is not allowed, “do-it-yourself” liquids are common and have handling risks and may sometimes contain toxic impurities. Though e-cigarettes should never be assumed safe products for non-smokers, for smokers, the e-cigarette is at least 20 times less dangerous than the cigarette. Tobacco cessation specialists in countries where nicotine containing e-cigarettes are available increasingly provide counselling for e-cigarette use to stop smoking or to reduce smoking at the request of patients. Based on current knowledge, for patients with lung or other forms of cancer who would otherwise continue to smoke, e-cigarettes offer an alternative way to quit smoking while they undergo medical treatment.

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1. Introduction

1.1. Tobacco kills

Any evaluation of e-cigarettes should consider the risks associated with smoking, which kills one out of two smokers [1]. Tobacco smoke killed 100 million smokers during the twentieth century [2]. It is the main preventable cause of death worldwide [3]. Anything that can reduce tobacco smoking can contribute to public health. The tobacco industry has designed its products to maintain the addiction of its customers and initiate teenagers into “tobacco dependence disease” [4]. Faced with tobacco lobbies, the nations of the World Health Assembly have established the Framework Convention on Tobacco Control (FCTC) which had 180 state parties in 2015 [5].

1.2. The emergence of e-cigarettes

The e-cigarette has profoundly changed the landscape of the fight against smoking, but it cannot address every aspect of the problem. It should be integrated within the spectrum of tobacco products and medications (NRT) with different risks and effectiveness as alternatives to cigarette smoking.

In this review, we focus on useful factual information about e-cigarettes for professionals who deal with lung cancer patients.

2. Origins and nature of e-cigarettes

2.1. History

After first experiments with nebulization of nicotine fifty years ago [6], the e-cigarette was invented by a pharmacist Hon Lik. The first 2006 US patents defined a product that works by nebulization. Now e-cigarettes work by vaporization of a liquid and creation of an aerosol of fine nicotine-containing droplets.

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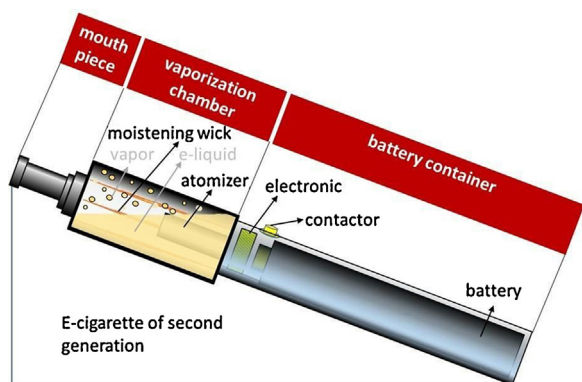


Fig. 1. Diagram of an e-cigarette.

2.2. What is an e-cigarette?

The electronic cigarette (e-cigarette), or “personal vapor device” or electronic nicotine delivery system (ENDS) is an emerging product that is neither a tobacco product nor a smoking cessation medication. It is a consumer product that blurs the boundaries between tobacco products and NRT [7]. In the EU, all countries will regulate this new product under the Tobacco Products Directive 2014/40/EU from May 2016 [8].

The product is comparatively recent and the early e-cigarette technology had poor nicotine delivery and was, therefore, a poor substitute for smoking. Remarkable progress has been made over the last four years and now the majority of e-cigarettes are effective nicotine delivery devices. The product has been largely used in US and in Europe where 13% of EU citizens (and 21% of French adults) had tried the product and 2% were using it on a daily basis in December 2014 [9].

2.3. General principle of vaporization

The principle of operation is based on passing the e-liquid over a heating coil (atomizer) supplied in a regulated manner by a battery. A solvent base of propylene glycol (PG) or glycerol (vegetable glycerine VG) is transformed from liquid state to aerosol state (vaporization) when heated by the atomizer. The aerosol is formed of fine droplets whose visual appearance can be similar to tobacco smoke or clouds. Scientifically this aerosol of fine droplets is not a vapor (i.e. a gas) but the word “vapor” is commonly used to describe the aerosol.

3. The e-cigarette device

3.1. E-cigarette types

All e-cigarettes operate on the same general principle. E-cigarette devices available on the market are of three broad types:

- first generation of e-cigarettes (cig-a-like) imitated the real tobacco cigarette in appearance.
- second generation e-cigarettes had the shape of large pen and are refillable.
- third generation e-cigarettes are completely modular (called ‘mods’, or ‘tanks and mods’) with separate batteries and atomizers. They bear no resemblance to tobacco products.

Other electronic nicotine delivery devices, such as e-shisha and e-pipes also operate on similar principles.

An e-cigarette may include (Fig. 1):

- A disposable or rechargeable battery.
- A pressure-sensitive sensor in the mouthpiece or a switch to activate heating of the device.
- An electronic control system with varying degrees of sophistication, allowing for control of power and battery charging and, more recently, control of coil temperature, and sometimes data on usage.
- A tank that holds the e-liquid, sometimes known as a clearomiser or cartomiser.
- A wick that directs the liquid to the heating element.
- An atomiser containing a heating coil in which the ‘vapor’ (aerosol) is produced.
- A mouthpiece through which the user draws the vapor.
- Decorative features such as LEDs or ornate patterns and designs. It is now rare to have simulated glowing red tips on products, though this was a feature of early cig-a-likes.

3.2. First generation – the cig-a-like

These e-cigarettes are shaped like cigarettes and are sometimes packaged in the same way as cigarettes. Some models had red or blue LED glowing tips to either imitate or differentiate them from tobacco cigarettes respectively. The heating of vapor is almost always triggered by inhalation pressure. The battery is often disposable single use and the amount of e-liquid allows for 50–200 puffs. These e-cigarettes are often marketed by the tobacco industry. They especially offer smokers to ability to continue taking nicotine puffs where smoking is prohibited. There are variations on this basic model with rechargeable batteries and e-liquid cartridges that are compatible with a specific branded device.

3.3. Second generation – the ‘pen’ type

Second generation e-cigarettes are refillable devices from small 10 mL or larger e-liquid vials or cartridges. The battery is rechargeable. The puff triggering is mostly manual by pressing a switch. The screw for assembling the part containing the battery and the vaporization chamber is standardized. The electronic control sometimes allows the user to change the electrical power applied to the heating coil.

3.4. Third generation – tanks and mods

This term ‘mods’ refers modular vaping devices, where the power supply is separate from the rest of the device – the ‘tank’. It can include large or small form batteries, a vast range of atomizer chambers of variable designs, usually made from steel and borosilicate glass and usually electronic control over power output and increasingly over coil temperature. The tanks and mods combinations and settings are endless. Often the air flow can be regulated to obtain a large puff volume by addition of fresh air.

3.5. Hazards related to the e-cigarette device

The devices have risks independent of the e-liquid:

- Electrical safety: the batteries of electronic cigarettes, as any advanced battery, can overheat and explode, usually as a result of a short circuit or through use of incompatible chargers [10]. These accidents are rare, but as for a mobile phone if overheating occurs, with hissing noises or deformation of the tank, users should be advised to stay away from the device as they would move away from a firecracker after lighting. All consumers should be made aware of this risk.

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