



International Journal of Current Research in Medical Sciences

ISSN: 2454-5716

www.ijcrims.com

Volume 2, Issue 12 -2016



Review Article

DOI: <http://dx.doi.org/10.22192/ijcrms.2016.02.12.004>

Electronic cigarettes: Human Friend or Foe

¹Das S, ²Sehgal VK, ³Vardhan A

¹Junior Resident, Department of Pharmacology, Government Medical College, Patiala, India.

²Associate Professor, Department of Pharmacology, Government Medical College, Patiala, India.

³Senior Resident, Department of Pharmacology, Andaman & Nicobar Islands institute of Medical Sciences, Port Blair, India.

Corresponding Author: **Dr Anand Vardhan**, E-mail: varanand.26@gmail.com

Abstract

Electronic nicotine delivery systems use is at a rise, such as electronic cigarettes (e-cigarettes), and people who are users and also who are non-users are exposed to the aerosol and product constituents. This review looks into the data which has been already published with effects on the human health and also the effects of exposure to e-cigarettes and their components. E-cigarette contains propylene glycol, glycerol, flavourings, other chemicals and, usually, nicotine in the form of aerosols. Aerosolised propylene glycol and glycerol are known to produce mouth and throat irritation further leading to dry cough. Aerosol exposure may be linked with respiratory function impairment, and serum nicotine levels are similar to those in traditional cigarette smokers. The high nicotine concentrations of some products increase exposure risks for non-users, particularly children. Recent evidences also suggest that electronic cigarettes as a less harmful alternative to smoking and significant health benefits are expected in smokers particularly those who switch from tobacco to electronic cigarettes. Further researches will help make electronic cigarettes more effective as smoking substitutes and will label them as a safe or unsafe alternative.

Keywords: electronic cigarettes, harm reduction, nicotine delivery system.

Introduction

Electronic cigarettes (e-cigarettes) use in current scenario is at a rise in both developed and developing countries. Although it does not involve tobacco combustion; but nicotine and the other components are aerosolised prior to inhalation. Decreased combustion causes reduced exposure of toxic elements for e-cigarette users as compared to the traditional cigarette smokers. Most of the available published data related to health effects do not include an evaluation of the effects on the population as a whole. This is a review of published data on the health effects associated with exposure to e-cigarettes with a focus on individual harm. Product addiction was

not considered in this review of health effects. Since their invention in 2003, manufacturers are constantly bringing new innovations in developing new and more efficient products. Currently, there are mainly three types of devices available [Dawkins, 2013], depicted in Figure 1. (1) First-generation devices, generally mimicking the size and look of regular cigarettes and consisting of small lithium batteries and cartomizers (i.e. cartridges, which are usually prefilled with a liquid that bathes the atomizer). Batteries may be disposable (to be used once only) or rechargeable. (2) Second-generation devices, consisting mainly of higher-capacity

lithium batteries and atomizers with the ability to refill them with liquid (sold in separate bottles). In the most recent atomizers you can simply change the atomizer head (resistance and wick) while keeping the body of the atomizer, thus reducing the operating costs. (3) Third-generation devices (also called 'Mods', from modifications), consisting of very large-capacity lithium batteries

with integrated circuits that allow vapors to change the voltage or power (wattage) delivered to the atomizer. These devices can be combined with either second-generation atomizers or with rebuildable atomizers, where the consumers have the ability to prepare their own setup of resistance and wick.^[1]

Figure 1: Products Available in market



Over 30 articles, from 2009 onwards and whose free full text available on the internet were analysed and included in the study by searching the internet database by using keywords related to ECs and/or their combination (e-cigarette, electronic cigarette, electronic nicotine delivery systems).

Results:

Health effects related to specific components of electronic cigarettes

Eighteen reviewed publications evaluated the health effects related to specific e-cigarette components. Aerosolisation of e-cigarette liquid (most commonly composed of water, propylene glycol (PG), glycerin, nicotine and flavourings) produces the 'smoke' that users, and potentially non-users, inhale.^[2] Factors which may contribute to inhalation effects of e-cigarettes include climate conditions, air flow, room size, number of users in the vicinity, type(s) and age of systems being used, battery voltage, puff length, interval between puffs, and user characteristics (eg, age, gender, experience, health status). Additionally,

particle size affects the site and effects of pulmonary absorption; details of e-cigarette aerosol particle size and absorption are unknown and likely vary depending on the product.^[3]

Glycol and glycerol vapour are components of most e cigarettes. Used in the theatre industry and for aviation emergency training, these are known upper airway irritants.^[4] Contact with glycol mist may also dry out mucous membranes and eyes.^[5] Glycerin is used therapeutically to increase the efficacy of inhalants; it has hygroscopic properties that draw water into bronchial secretions and reduces their viscosity. Glycerin and PG did not cause cytotoxic effects when human embryonic stem cells, mouse neural stem cells, and human pulmonary fibroblasts were exposed to several e-cigarette refill solutions.^[6] The repeated and potentially long-term inhalation of glycerol vapour associated with e-cigarette use, however, differs from exposure levels in the entertainment industry; currently available data are not sufficient to determine long-term safety. E-cigarettes, however, may pose increased risk of nicotine toxicity due to the availability of high nicotine concentrations in the cartridges.^[7]

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 associated with e cigarettes may be fewer and less toxic than those from traditional cigarettes, data to establish whether e-cigarette use as a whole is less harmful to the individual user than traditional cigarettes are not conclusive. Studies reviewed noted the following observed physiologic effects associated with acute exposure to e-cigarettes or e-cigarette aerosols:

1. mouth and throat irritation and dry cough at initial use, though complaints decreased with continuing use.^[8]
2. no change in heart rate, carbon monoxide (CO) level, or plasma nicotine level.^[9]
3. decrease in fractional exhaled nitric oxide (FeNO) and increase in respiratory impedance and respiratory flow resistance similar to cigarette use.^[10]
4. no change in complete blood count (CBC) indices.^[11]
5. no change in lung function.^[12,13]
6. no change in cardiac function as measured with echocardiogram.^[14]
7. no increase in inflammatory markers.^[15]

Summary of chemical toxicity findings.

Study with Year	Findings
Laugesen ^[16] [2009]	Evaluated 62 toxicants in the EC vapour from Ruyan 16 mg and mainstream tobacco smoke using a standard smoking machine protocol. The study results were that acrolein was not found, but small quantities of acetaldehyde and formaldehyde found. Traces of TSNAs (NNN, NNK, and NAT) detected. CO, metals, carcinogenic PAHs and phenols not found in EC vapour. Acetaldehyde and formaldehyde from tobacco smoke were 55 and 5 times higher, respectively.
Westenberger ^[17] [2009]	Evaluated the toxicants in EC cartridges from two popular US brands. And found that TSNAs and certain tobacco specific impurities were detected in both products at very low levels. Diethyleneglycol was identified in one cartridge.
Hadwiger ^[18] <i>et al.</i> [2010]	Did evaluation of four refill solutions and six replacement cartridges advertised as containing Cialis or rimonabant. The study results were that small amounts of aminotandalafil and rimonabant present in all products tested.
Cahn and Siegel ^[19] [2011]	Did overview of 16 chemical toxicity studies of EC liquids/ vapours and concluded that TSNAs levels in ECs 500- to 1400-fold lower than those in conventional cigarettes and similar to those in NRTs. Other chemicals found very low levels, which are not expected to result in significant harm.
Kim and Shin ^[20] [2013]	Investigated the TSNAs (NNN, NNK, NAT, and NAB) content in 105 refill liquids from 11 EC brands purchased in Korean shops and concluded that total TSNAs averaged 12.99 ng/ml EC liquid; daily total TSNA exposure from conventional cigarettes estimated to be up to 1800 times higher.
Etter <i>et al.</i> ^[21] [2013]	Investigated Nicotine degradation products, ethylene glycol and diethylene glycol evaluation of 20 EC refill liquids from 10 popular brands and found The levels of nicotine degradation products represented 0–4.4% of those for nicotine, but for most samples the level was 1–2%. Neither ethylene glycol nor diethylene glycol were detected.

Williams et al. ^[22] [2013]	Studied the Vapour generated from cartomizers of a popular EC brand using a standard smoking machine protocol and concluded that Trace levels of several metals (including tin, copper, silver, iron, nickel, aluminium, chromium, lead) were found, some of the at higher level compared with conventional cigarettes. Silica particles were also detected. Number of microparticles from 10 EC puffs were 880 times lower compared with one tobacco cigarette.
Burstyn ^[23] [2014]	Did Systematic review of 35 chemical toxicity studies/technical reports of EC liquids/vapours and concluded that no evidence of levels of contaminants that may be associated with risk to health. These include acrolein, formaldehyde, TSNAs, and metals. Concern about contamination of the liquid by a nontrivial quantity of ethylene glycol or diethylene glycol remains confined to a single sample of an early technology product and has not been replicated.

Abbreviations. CO, carbon monoxide; EC, electronic cigarette; NAT, N-Nitrosoanatabine; NNK, 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone; NNN, N-Nitrosornicotine; PAHs, polycyclic aromatic hydrocarbons; PM, particulate matter; TSNAs, tobacco-specific nitrosamines; VOCs, volatile organic carbons.

Discussion

E-cigarettes have the potential for significant impact on public health. The regulation of e-cigarettes varies from country to country. Of the 33 countries that responded to a 2011 WHO survey about regulation and availability of e-cigarettes within their country, 13 reported no availability, 16 reported they were available (nine unregulated, seven with some type of regulation), and four were unsure.^[24] Although the sale, use and advertising of e-cigarettes are permitted in the USA, some individual states have imposed restrictions. As noted by Trtchounian and Talbot, the effects of policies, regulations, healthcare costs and any health benefit for users or the general population will be difficult to assess unless e-cigarettes are a regulated product.^[25]

Conclusion

While the majority of studies demonstrate a positive relationship between e-cigarette use and smoking cessation, the evidence remains inconclusive due to the low quality of the research published to date. Well-designed randomized controlled trials and longitudinal, population

studies are needed to further elucidate the role of e-cigarettes in smoking cessation.

References

1. Konstantinos E. Farsalinos and Riccardo Polosa, Safety evaluation and risk assessment of electronic cigarettes as tobacco cigarette substitutes: a systematic review. *Ther Adv Drug Saf* 2014, Vol. 5(2) 67– 86.
2. Caponnetto P, Campagna D, Papale G, et al. The emerging phenomenon of electronic cigarettes. *Expert Rev Respir Med* 2012;6:63–74.
3. Etter JF, Bullen C, Flouris AD, et al. Electronic nicotine delivery systems: a research agenda. *Tob Control* 2011;20:243–8.
4. ENVIRON International Corporation. Equipment-based guidelines for the use of theatrical smoke and haze. Report prepared for Equity-League Pension and Health Trust Funds, 2001. <http://www.actorsequity.org/docs/safesan/equipment-based.pdf> (accessed December 2016).

5. Raymond GE. Recommended exposure guidelines for glycol fogging agents. Report prepared for Entertainment Services and Technology Association, 1997. <http://www.lemaitreltd.com/pdf/Cohen%20Report.pdf> (accessed December 2016).
6. Bahl V, Lin S, Xu N, et al. Comparison of electronic cigarette refill fluid cytotoxicity using embryonic and adult models. *Reprod Toxicol* 2012;34:529–37.
7. Ordonez J, Forrester MB, Kleinschmidt K. Electronic cigarette exposures reported to poison centers. *Clin Toxicology* 2013; 51:685.
8. Polosa R, Morjaria JB, Caponnetto P, et al. Effectiveness and tolerability of electronic cigarette in real-life: a 24-month prospective observational study. *Intern Emerg Med* Published Online First: 20 Jul 2013. doi:10.1007/s11739-013-0977
9. Vansickel AR, Cobb CO, Weaver MF. A clinical laboratory model for evaluating the acute effects of electronic cigarettes: nicotine delivery profile and cardiovascular and subjective effects. *Cancer Epidemiol Biomarkers Prev* 2010;19:1945–53.
10. Vardavas CI, Anagnostopoulos N, Kougias M, et al. Short-term pulmonary effects of using an electronic cigarette. *Chest* 2012; 141:1400–6.
11. Flouris AD, Poulianiti KP, Chorti MS, et al. Acute effects of electronic and tobacco cigarette smoking on complete blood count. *Food Chem Toxicol* 2012; 50:3600–3.
12. Chorti M, Pouliantis K, Jamurtas A, et al. Effects of active and passive electronic and tobacco cigarette smoking on lung function. *Abstracts/Toxicol Lett* 2012;21(1S):64.
13. Flouris AD, Chorti MS, Poulianiti KP, et al. Acute impact of active and passive electronic cigarette smoking on serum cotinine and lung function. *InhalToxicol* 2013; 25:91–101.
14. Farsalinos K, Tsiapras D, Kyrzopoulos S, et al. Acute effects of using an electronic nicotine-delivery device (e-cigarette) on myocardial function: comparison with the effects of regular cigarettes. *Eur Heart J* 2012;33(Supp 1):203.
15. Tzatzarakis MN, Tsitoglou KI, Chorti MS, et al. Acute and short term impact of active and passive tobacco and electronic cigarette smoking on inflammatory markers. *Toxicol Lett* 2013; 221S:S86.
16. Laugesen, M. (2009). RuyanRE-cigarette Bench-toptests. Society for Research on Nicotine and Tobacco (SRNT) Dublin, Poster 5-11. Available at: <http://www.healthnz.co.nz/DublinEcigBenchtoPHandout.pdf> [accessed december 2016].
17. Westenberger, B. (2009) Evaluation of e-Cigarettes. St. Louis, MO: Department of Health and Human Services, Food and Drug Administration, Center for Drug Evaluation and Research, Division of Pharmaceutical Analysis. Available at: <http://www.fda.gov/downloads/drugs/Scienceresearch/UCM173250.pdf> (Accessed: December, 2016).
18. Hadwiger, M., Trehly, M., Ye, W., Moore, T., Allgire, J. and Westenberger, B. (2010) Identification of amino-tadalafil and rimonabant in electronic cigarette products using high pressure liquid chromatography with diode array and tandem mass spectrometric detection. *J Chromatogr A* 1217:7547–55.
19. Cahn, Z. and Siegel, M. (2011) Electronic cigarettes as a harm reduction strategy for tobacco control: a step forward or a repeat of past mistakes? *J Public Health Policy* 32: 16–31.
20. Kim, H. and Shin, H. (2013) Determination of tobacco-specific nitrosamines in replacement liquids of electronic cigarettes by liquid chromatography and mass spectrometry. *J Chromatogr A* 1291:48–55.
21. Etter, J., Zäther, E. and Svensson, S. (2013) Analysis of refill liquids for electronic cigarettes. *Addiction* 108: 1671–79.
22. Williams, M., Villarreal, A., Bozhilov, K., Lin, S. and Talbot, P. (2013) Metal and silicate particles including nanoparticles are present in electronic cigarette cartomizer fluid and aerosol. *PLoS One* 8: e57987.
23. Burstyn, I. (2014) Peering through the mist: Systematic review of what the chemistry of contaminants in electronic cigarettes tells us about health risks. *BMC Public Health* 14: 18.

24. CoP to the FCTC Electronic nicotine delivery systems, including electronic cigarettes. Report by the Convention Secretariat (FCTC/COP/5/13), 2012. http://apps.who.int/gb/fctc/PDF/cop5/FCTC_COP5_13-en.pdf (accessed 10 December 2016).
25. Trtchounian A, Talbot P. Electronic nicotine delivery systems: is there a need for regulation? *Tob Control* 2011; 20:47–52.

Access this Article in Online	
	Website: www.ijcrims.com
	Subject: Health Sciences
Quick Response Code	

[How to cite this article:](#)

Das S, Sehgal VK, Vardhan A. (2016). Electronic cigarettes: Human Friend or Foe. *Int. J. Curr. Res. Med. Sci.* 2(12): 21-26.

DOI: <http://dx.doi.org/10.22192/ijcrms.2016.02.12.004>