Review Article *Open Access*

Journal of Psychiatric Insight Review

ISSN: 3067-9249

DOI: doi.org/10.63721/25JPIR0113

The Dual Nature of Vaping—Harm Reduction or Public Health Threat?

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Citation: Richmond Ronald Gomes, Tohura Sharmin, Abir bin Sajj (2025) The Dual Nature of Vaping—Harm Reduction or Public Health Threat?. J. of Psy Ins Review 1(4), 1-4. WMJ/JPIR-113

Abstract

Electronic cigarettes (e-cigarettes), commonly known as vapes, have rapidly gained popularity as an alternative to traditional tobacco smoking. Initially introduced as a smoking cessation aid, vaping has evolved into a major public health concern due to its widespread use among adolescents and uncertainties regarding long-term health effects. This article reviews the current evidence on vaping, including its mechanism, potential benefits for adult smokers, and associated health risks, particularly among youth. While vaping may offer harm reduction for current smokers, its appeal to non-smokers and lack of long-term safety data necessitate stricter regulations and further research.

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Submitted: 08.09.2025 **Accepted:** 11.09.2025 **Published:** 05.10.2025

Keywords: E-Cigarettes, Vaping, Nicotine, Smoking Cessation, Harm Reduction, Public Health

Introduction

Electronic cigarettes, or e-cigarettes entered the global marketplace around 2006 [1]. In 2009, the World Health Organization (WHO) coined the term Electronic Nicotine Delivery Systems (ENDS) to denote the many types of e-cigarette devices that contained nicotine [2].

An electronic cigarette (e-cigarette), or vape, is a device that simulates smoking [3]. It consists of an atomizer, a power source such as a battery, and a container such as a cartridge or tank. Instead of smoke, the user inhales vapor [4]. As such, using an e-cigarette is often called "vaping".

Vaping, or the use of electronic cigarettes (e-cigarettes), has emerged as a contentious topic in public health. Marketed as a safer alternative to traditional

smoking, e-cigarettes deliver nicotine without combustion, reducing exposure to harmful tar and carcinogens. Studies suggest they may aid smoking cessation, with some evidence showing higher success rates than nicotine replacement therapies.

However, vaping is not without risks. The inhalation of aerosolized chemicals, including nicotine, formaldehyde, and flavoring agents, raises concerns about respiratory and cardiovascular health. Additionally, the surge in youth vaping—driven by appealing flavors and aggressive marketing—has sparked fears of a new generation addicted to nicotine. Regulatory responses vary globally, with some countries imposing strict bans while others adopt harm-reduction approaches.

While vaping may benefit adult smokers transitioning away from combustible tobacco, its long-term health effects remain uncertain. Policymakers must balance harm reduction with stringent regulations to prevent underage use and ensure product safety. Further research is essential to clarify vaping's role in tobacco control and public health.

What is Vaping?

Device Mechanics and Components:

E-cigarettes consist of:

- **Battery:** Powers the heating element.
- **Atomizer/Coil:** Heats the e-liquid to produce aerosol.
- **A cartridge/tank** (holds the e-liquid)
- **E-liquid (Vape Juice):** Contains nicotine, propylene glycol (PG), vegetable glycerin (VG), and flavorings.

Unlike combustible cigarettes, e-cigarettes do not produce tar or carbon monoxide, theoretically reducing exposure to carcinogens.

Types of Vaping Devices

- **Cigalikes:** Resemble traditional cigarettes.
- **Vape Pens:** Larger, refillable devices.
- **Pod Systems (e.g., JUUL):** Compact, high-nicotine devices popular among youth.
- **Mods:** Customizable, high-powered devices.
- **E- hookahs**

Potential Benefits of Vaping

- **Smoking Cessation Tool:** Several studies suggest that e-cigarettes may help smokers quit or reduce tobacco use. A 2019 randomized controlled trial published in The New England Journal of Medicine found that e-cigarettes were more effective than nicotine replacement therapy (NRT) for smoking cessation [5-7].
- **Harm Reduction:** Public Health England (PHE) estimates that vaping is 95% less harmful than smoking. By eliminating combustion, e-cigarettes reduce exposure to carcinogens, potentially lowering smoking-related diseases.

Health Risks and Concerns

Respiratory and Cardiovascular Effects

- **EVALI (E-cigarette or Vaping Product Use-Associated Lung Injury) [8]:** Linked to vitamin E acetate in THC-containing vapes, this condition caused outbreaks in 2019.
- **Increased Heart Rate & Blood Pressure:** Nicotine's vasoconstrictive effects may elevate cardiovascular risks.
- **Respiratory Effects:** Chronic vaping may cause bronchial irritation and worsen asthma [9,10].
- **Carcinogenic:** Several studies have also suggested that nicotine is potentially carcinogenic [11].

Youth Vaping Epidemic

1. Flavored e-liquids (e.g., fruit, candy, mint) appeal to adolescents, leading to a surge in underage vaping.
2. Nicotine exposure during adolescence may cause nicotine addiction and impair brain development.

Chemical Exposure

1. Some e-liquids contain formaldehyde, acrolein, and heavy metals (e.g., lead, nickel) at varying levels.
2. Long-term inhalation of flavoring agents (e.g., diacetyl) may pose respiratory risks.

Implication of E-Cigarette Consumption in COVID-19 Time

Different reports have pointed out that smokers and vapers are more vulnerable to SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2) infections or more prone to adverse outcomes if they suffer COVID-19 [12]. Interestingly, most of these reports linking COVID- 19 harmful effects with smoking or vaping, are based on their capability of increasing the

expression of angiotensin- converting enzyme 2 (ACE2) in the lung. It is well known that ACE2 is the gate for SARS-CoV-2 entrance to the airways [13] and it is mainly expressed in type 2 alveolar epithelial cells and alveolar macrophages. However, while a recent report indicated that e-cigarette vaping also caused nicotine-dependent ACE2 upregulation [14]. Nevertheless, additional complications associated to COVID-19 are increased thrombotic events and cytokine storm. In the lungs, e-cigarette consumption has been correlated to toxicity, oxidative stress, and inflammatory response [15,16]. More recently, a study revealed that while the use of nicotine/flavor-containing e-cigarettes led to significant cytokine dysregulation and potential inflammasome activation, none of these effects were detected in non-flavored and non-nicotine-containing e-cigarettes [17]. Therefore, taken together these observations, e-cigarette use may still be a potent risk factor for severe COVID-19 development depending on the flavor and nicotine content.

Conclusion

Vaping presents a paradox: it may offer a less harmful alternative for adult smokers while posing significant risks for youth and non-smokers. However, a stricter sale control, a proper regulation of the industry including flavor restriction, as well as further toxicological studies, including their chronic effects, are warranted.

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