Vaping and Public Health: Scientific Evidence, Therapeutic Controversies, and Regulatory Challenges in Adolescents

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Several types of electronic cigarettes or vapes are currently available on the market. The World Health Organization (WHO) classifies them into two categories: electronic nicotine delivery systems (ENDS) and electronic non-nicotine delivery systems (ENNDS) (WHO, 2016). Both have health implications, as they operate in a comparable way (WHO, 2020). Moreover, health alerts have been issued because some products labeled as ENNDS contain nicotine despite their packaging indicating otherwise (Guraka et al., 2024; Miller et al., 2021; Omaiye et al., 2017). These devices operate using a battery and a metal heating element that vaporizes a mixture of substances known as electronic liquids (e-liquids), producing aerosols that are inhaled and exhaled by the user, a practice known as vaping (Baldassarri, 2020).

The characteristics and composition of the aerosol produced by vapes vary depending on factors such as battery power, the chemical components present in e-liquids, the topography of consumption, and atomizer design (Williams & Talbot, 2019).

According to the specialized literature, four generations of electronic vaping devices exist. The first generation is shaped like a conventional cigarette, is disposable, and uses low-voltage batteries. The second generation features variable voltage batteries and pre-filled or refillable tanks enabling users to adjust the nicotine concentration. The third generation is characterized by larger capacity tanks, customizable coils, and the ability to replace atomizer components. Finally, the fourth generation includes more compact devices using interchangeable capsules or pods integrating both the e-liquid reservoir and the heating coil (Baldassarri, 2020; Starnini et al., 2025; Williams & Talbot, 2019).

The e-liquids used in these devices are typically made with a base of propylene glycol and vegetable glycerin (Starnini et al., 2025) acting as a carrier for a complex blend of chemical compounds and flavorings (Pennington & Hernandez, 2025), as well as nicotine, either in its free form or as nicotine salts (Harris, 2024).

The heating process creates carbonyl byproducts and other reactive compounds in the aerosol, the concentration of which depends on the e-liquid's formulation and the type of heating used (Harris, 2024). Contact between the liquid and the metal components of the atomizer and coil degradation contribute to the presence of metals and metalloids (Schmidt, 2024). Moreover, in recent years, a rise in nicotine concentration has been observed, increasing the addictive potential of these products (Diaz et al., 2025).

Despite the evidence presented above, the expert community proposes the use of electronic nicotine replacement therapy (ENRT) devices as a therapeutic tool to reduce withdrawal symptoms and promote smoking cessation. Positive results have been shown in pregnant women (Przulj et al., 2023) and in adults planning to quit smoking (Levett et al., 2023).

Moreover, ENRT devices have been observed to be more effective in achieving abstinence than ENNDS, nicotine patches, and other therapeutic treatments (Levett et al., 2023).

However, the use of these devices for therapeutic purposes requires strict policies and regulations to ensure controlled doses of nicotine, given that many devices contain higher concentrations than conventional cigarettes (Diaz et al., 2025). Good

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manufacturing practices with quality standards and monitoring of components and concentrations are also required (Guraka et al., 2024). Access must be restricted to people with nicotine dependence who use them for therapeutic purposes and under medical supervision (Peri & Eisenberg, 2024). Finally, greater investment in research is needed to evaluate the risks associated with their use in clinical contexts (Feeney et al., 2022).

At the same time, there is also a proposal to use vapes as a harm reduction measure for smokers who do not wish to quit nicotine. These smokers are willing to change their consumption method (from smoking to vaping) on the assumption that vaping presents a lower risk of developing medical conditions.

This proposal has prompted the scientific community to investigate its true impact on health (Allbright et al., 2024).

In this regard, a systematic review with meta-analysis was recently published, indicating that the use of electronic devices minimally reduces the risk of developing conditions such as asthma, chronic obstructive pulmonary disease (COPD), and stomatological diseases. However, evidence indicates that the risks of developing cardiovascular diseases, strokes, and metabolic dysfunctions are like those of conventional cigarette consumption. Additionally, people with dual consumption (smoking both conventional and e-cigarettes) have a 20% to 41% increase in the risk of developing any type of related disease, compared to exclusive conventional smokers (Glantz et al., 2024).

According to Hatsukami & Carroll (2020), the use of vapes as a harm reduction measure is controversial. Although smokers who do not wish to quit can benefit from reducing their exposure to combustion toxins, the devices pose new risks to non-smokers and younger generations. In this regard, the WHO (2023, 2024a, 2025) has urged countries to strengthen their public policies for the regulation, prevention and protection of children and adolescents. It points out that the industry's marketing strategies represent a threat by using attractive flavors, bright colors, and animated characters. These campaigns reduce the perception of risk through promotions, gifts, sponsorships at youth events and accelerated launches of new products taking advantage of regulatory gaps.

In addition, they are displayed in convenience stores alongside sweets and snacks (WHO, 2024b; Gaiha et al., 2024).

Leading brands in the sector, such as JUUL, PAX, and PLOOM, have employed marketing strategies that present vaping as a modern lifestyle, targeting young audiences. This includes promotion on social networks through memes and teenage slang (Czaplicki et al., 2020; Gaiha et al., 2024) and insertion in popular media such as television, film, and music videos (Wakefield et al., 2025). Vaping devices are also presented as technological innovations with attractive designs (Jackler et al., 2019).

Given that vaping is a relatively recent product, several authors have underlined the need to assess the magnitude of the phenomenon and its impacts on the youth population (Novak & Wang, 2024). In this regard, evidence indicates that one in five Latin American adolescents has used e-cigarettes (Izquierdo-Condoy et al., 2024) and that adolescents who vape are three times more likely to start smoking conventional cigarettes than those who do not (Golder et al., 2025). Other research reports reveal that chronic vaping in children and adolescents is associated with airway fibrosis or constrictive bronchiolitis (Hariri et al., 2022). It is known to increase the risk of developing nicotine addiction, as well as cognitive impairments (attention and memory).

It also disrupts the circadian rhythm, in addition to producing anxiety, depression, and emotional dysregulation symptoms (Abdulhay et al., 2025; Javed et al., 2022; Meehan et al., 2024). In general, evidence indicates that nicotine exposure in this age group increases the risk of developing mental disorders due to its impact on the cholinergic and dopaminergic systems during neurodevelopment (Reynolds et al., 2025).

In Mexico, although the sale of electronic vaping devices is prohibited, data from the National Health and Nutrition Survey (ENSANUT) show a worrying change. Between 2018 and 2023, combustible tobacco consumption among young people aged 15 to 19 years decreased from 9.8% to 5%, while the exclusive use of vapes increased from 1.3% to 6.6% (Barrera-Núñez et al., 2025). In parallel, records from Centros de Integración Juvenil (CIJ) show an increase of over 2300% in lifetime nicotine use in electronic devices. The number of cases rose from 72 (1.1%) in the first half of 2021 to 1,738 (15.9%) in the first half of 2025. This phenomenon is observed across almost the entire country, with a higher prevalence in men (68.2%) than women (31.8%). The average age of onset of use is 16.5 years (SD = 6.4), and in 7.2% of cases, vaping was the main reason for consultation (Centros de Integración Juvenil, 2025a). Additionally, CIJ conducted a multisite cross-sectional survey in approximately 773 middle and high schools nationwide, including a sample of nearly 115,000 students. Preliminary findings revealed that 28% reported using vapers (Centros de Integración Juvenil, 2025b).

Taken together, the available evidence underlines that vaping in adolescents cannot be considered a harmless alternative or an effective tool for harm reduction. The sustained increase in the prevalence of vaping anticipates an overdemand for specialized services for cessation and the care of associated medical consequences, which will increase the healthcare burden and public cost in the coming years. In this context, it is essential to establish an inter-institutional, inter-sectoral agenda focused on developing innovative prevention, treatment, and public policy strategies. The aim of these strategies would be to counteract the technological and symbolic appeal of these devices to strengthen the protection of new generations against nicotine dependence.

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