

REVIEW

Vaping as a new threat for respiratory health: a position statement from the Italian Pediatric Respiratory Society

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ABSTRACT

Electronic Nicotine Delivery Systems such as electronic cigarettes and heated tobacco products are more and more commonly used among youth worldwide. Even if such devices are proposed as a healthier alternative to conventional cigarettes smoking, many studies are reporting potential detrimental health effects both *in vitro* and in animals and humans. Regarding the lungs and airways, acute vape exposure causes mainly inflammation, bronchial hyperreactivity and reduced response to infections. The long-term effects of active and passive vaping are still largely unknown, but the presence of toxicants and carcinogens in vape suggest caution, especially when considering the first limited reports on increased risk of lung cancer. Second and third – hand exposure to vaping is likely to be harmful too, especially in childhood. Moreover, children and adolescents are at increased risk of addiction to nicotine, which is often present at high concentration in e-liquids and pod-mods. Notably, vape exposure may be harmful also during pregnancy, by contributing to preterm birth and low weight at birth. The Italian Pediatric Respiratory Society (SIMRI) has been involved and has proposed many different activities on smoking prevention in the last decades. In such a scenario, a group of SIMRI members proposed and obtained to create a Task Force with the goal of producing the first and up-to-date SIMRI recommendations on vaping, which are provided in this paper. To protect children and adolescents, SIMRI experts underline the need to educate paediatricians and families on this issue, to implement prevention campaigns, to ensure smoke-free and vaping-free environments and to reduce tobacco industry interference especially on social media.

IMPACT STATEMENT

SIMRI acknowledges that vaping represents a serious threat to respiratory health in children and adolescents and proposes ten recommendations to take action.

INTRODUCTION

The term “Electronic Nicotine Delivery Systems” (ENDS) includes many different electronic devices producing a visible aerosol called “vape” which delivers

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ABBREVIATIONS

CC = Combustion Cigarette/s

EC = Ecigarette/s

ENDS = Electronic Nicotine Delivery Systems

EVALI = E-cigarette or Vaping use Associated Lung Injury

HTP = Heated Tobacco Products

SIMRI = Italian Pediatric Respiratory Society (Società Italiana per le Malattie Respiratorie Infantili)

US = United States

KEY WORDS

Children; e-cigarette; EVALI; heated tobacco products; vape.

nicotine without any combustion process (see glossary, **Table 1**). Electronic Cigarettes (EC) are the most common example of ENDS (1), appeared on the market in 2003 when the Chinese pharmacist Hon Lik proposed them as an alternative to traditional Combustion Cigarettes (CC). In 2006 EC arrived in Europe and the United States (US) and then spread worldwide, gaining increasing success. In 2014 new devices producing aerosol by heating tobacco sticks (HTP) appeared on the market, and they are now more and more commonly used, especially by young people. In 2023 vapers were around 80 million worldwide (2). In Italy, according to recent data from the Global Youth Tobacco Survey carried out by the “Smoke, Alcohol and Drug Observatory” within the Italian National Institute of Health, current and ever smokers are continuously reducing, with only 2% of adolescents using only CC. However, vaping has increased in 2023 by about 14%, with 1 adolescent out of 4 having used at least one tobacco product including ENDS. Vaping has already become the most

used tobacco product among adolescents in other countries such as the US (3, 4), where an estimated 1.6 million middle and high school students currently use EC (5). The widespread diffusion of EC is associated with a mistaken awareness that they are a healthier alternative to CC. On the contrary, direct and indirect exposure to the products of these devices is not free of risks so that the spreading of vaping especially among children and adolescents has become a significant public health problem, considering that it also facilitates nicotine addiction and transition to the use of CC (6). In the last few years, many scientists have become aware of the potential harms caused by vaping, and a growing number of studies showing such effects mostly *in vitro* and in animal models, but also in humans, have been published. The position statements and recommendations on vaping from the European Respiratory Society (7), the Forum of International Respiratory Societies (8), the European Board of Pediatrics (9) and American Academy of Pediatrics (10), tried to raise aware-

Table 1. Vaping glossary.

Cloud-chasing	Vapers use this technique to create different types of aerosol plume in a sort of competition.
Dripping	Vaping technique in which denser vape is generated by manually dripping e-liquids directly onto the heating coils.
Dual user	User of both electronic cigarettes and traditional combustion cigarettes.
E-Cigarette	Electronic devices that simulate the act of smoking by aerosolizing e-liquids instead of burning tobacco.
ENDS	“Electronic Nicotine Delivery Systems” is a generic term used to identify all electronic devices available to deliver nicotine without tobacco combustion.
EVALI	“ <i>E-cigarette or Vaping use-Associated Lung Injury</i> ” is an acute lung condition characterized by respiratory distress, abnormal chest CT, absence of signs of pulmonary infection or any other plausible diagnoses and a recent history of vaping. Some Authors proposed introducing also the term EVALD (“ <i>E-cigarette or Vaping use-Associated Lung Disease</i> ”) to underline that vaping may cause different types of lung disease and not only acute injury.
Heat-not-burn devices / Heated tobacco products	Electronic devices generating aerosol by heating up sticks of tobacco, without burning it.
Puff	The term refers to disposable and cheap electronic cigarettes resembling rechargeable pod-mods, the use of which is spreading among adolescents.
Stealth Vaping	The act of vaping in a discreet manner by using small quantities of vape or particularly small devices.
Triple user	Users of traditional combustion cigarettes together with electronic cigarettes and heated tobacco products.
Smoker	Traditional combustion cigarettes user.
Vape	The aerosol produced by ENDS which appears denser than that produced by combustion cigarettes. The act of inhaling and exhaling vape is known as “vaping”.
Vaper	Electronic cigarette user.

Table 2. SIMRI Call to action for pediatricians.**10 rules to protect our children from vaping exposure**

- 1 Pediatricians must be aware that mounting evidence shows that vaping threatens children's health and particularly respiratory health, in a similar way cigarettes do, and that they should routinely screen their patients and families for vaping.
- 2 Children and adolescents are at increased risk of addiction to nicotine and they should be protected from tobacco industry interference especially on social media.
- 3 First-hand exposure to vaping may cause acute and chronic lung damage, and respiratory symptoms such as cough, phlegm, dyspnea, wheezing and asthma exacerbations.
- 4 Second and third - hand exposure to vaping is likely to be harmful and should be avoided, especially in childhood.
- 5 Pregnant women must be routinely screened for vaping, and informed and counselled on the risks related to vaping during pregnancy.
- 6 Even if there is still no clear evidence on e-liquids and vaping carcinogenicity, following the precautionary principle it is strongly suggested to avoid any kind of exposure, especially if prolonged.
- 7 It is mandatory to ensure smoke-free and vaping-free environments, including indoor locations.
- 8 We suggest electronic nicotine delivery systems should be regulated as tobacco products, including bans on flavorings and on child-friendly packaging, which should be enforced.
- 9 Tobacco policy across Europe should be aligned with the objectives and political efforts promoted by the World Health Organization Framework Convention on Tobacco Control.
- 10 Urgent implementation campaigns to prevent the initiation of vaping among youth, including counselling plans focused on the risks of vaping in schools, which should be promoted locally and at a national level.

ness on the subject. The Italian Pediatric Respiratory Society (SIMRI), which is a partner of the Italian Pediatric Society, has been involved and has proposed many different activities on smoking prevention, including projects to make paediatricians part of the smoking cessation process and scientific events focused on vaping. In 2023 a group of SIMRI members proposed and obtained to create a Task Force with the goal of producing the first and up-to-date SIMRI recommendations on vaping, which are reported in **Table 2**. This paper outlines existing scientific data on EC and HTP, which was evaluated by searching relevant published studies in the MEDLINE/PubMed database in the last 10 years (the original search was run in March 2024 and updated in September 2024). The position statement was reviewed and approved by SIMRI executive committee in November 2024.

WHAT ARE E-CIGARETTES AND HEATED TOBACCO PRODUCTS?

EC are the most used ENDS: such devices are usually composed of three main components: an atomizer, a liquid storage unit, and a power source. The atomizer heats the e-liquid so that it can be vaporized and inhaled by the user. Four generations of EC are identifiable: the

first generation of EC looked like CC (the *cig-a-likes*), the second one are the so-called *vape-pens*, which have a refillable tank, while the third generation is represented by bigger devices allowing the user to customize voltage and wattage thus varying the temperature of the aerosol (the higher the temperature, the stronger the "hit" felt in the throat). The most recent EC are the *pod-mods*: these fourth EC generation devices resemble USB drives, are cheaper, easily conceivable and reusable, and are getting tremendous success among youth, especially the disposable ones. The pod-mods are particularly worrisome since they use nicotine salts with benzoic acid, which let the user inhale high quantity of nicotine in a short time, since they do not cause harshness or irritation (11, 12). E-liquids are composed mainly of solvents such as vegetable glycerin and propylene glycol, which produce the visible cloud while vaping, added with flavouring additives, which give vape a distinctive flavour. Nicotine is commonly found in e-liquids, even in those declared as nicotine-free, potentially in very high concentrations (up to 50 mg/mL). Notably, e-liquids may contain toxic and/or irritative substances, such as tobacco alkaloids and nitrosamines, volatile organic compounds, formaldehyde, acetaldehyde, acrolein, and metals (13). Heated Tobacco Products (HTP) are electric devices that produce aerosol by heating tobacco up to about 350°C.

Three main designs of HTP are available: i) electrically HTP (eHTP): vape is produced by heating a stick containing reconstituted tobacco and flavouring additives which must be inserted in the device by the user; ii) aerosol HTP: a warmed aerosol is passed through the tobacco sticks; iii) carbon HTP: vape is produced by heating a tobacco substrate through a smoldering carbon rod (14, 15). eHTP currently dominate the market. Increasingly available evidence shows that, even if the content of nicotine and toxicants in HTP vape seems to be lower than that in CC, the concentrations of some harmful constituents are higher in HTP than in CC, and several toxic compounds are uniquely present in HTP and not in CC smoke (16, 17).

NICOTINE AND EXPOSURE TO OTHER SUBSTANCES

The growing availability of different ENDS makes it difficult to clarify which substances such devices contain and deliver to the users, depending also on the user's vaping habits and device customization. However, some studies have already tried to shed light on the issue. Regarding e-liquids, their chemical composition may appear somehow simpler than that of CC and tobacco smoke, since the producers state that they contain the following four main components: i) nicotine, ii) vegetable glycerin, iii) propylene glycol, iv) flavourings (18). While a single CC contains about 10 mg of nicotine and delivers 1-2 mg when smoked, in e-liquids, the amount of nicotine is higher and varies between 15 and 50 mg/mL (with a limit of 20 mg/mL set by the Tobacco Products Directive in the European Union) (19) and the level of nicotine in vape in common conditions of use varies between 0.5 and 15 mg according to some studies performed via an automatic smoking machine using different EC (20, 21). As for pod-mods, a single pod may deliver in limited time about 15-30 mg of nicotine, with equivalence to 13-30 CC (22). Regarding vegetable glycerin and propylene glycol, these solvents are commonly used in the food and cosmetics industry and are included in the Food and Drug Administration *generally recognized as safe* list considering such use, but not inhalation. Notably, repeated inhalation of these molecules can be harmful, since they are hygroscopic and may irritate the bronchial mucosa, as demonstrated by the fact that cinema and theatre workers develop cough

and dyspnoea when repeatedly exposed to stage smoke (23). As for flavours, more than 15.000 different flavours are currently available on the market, to make EC more attractive and popular especially among young people (24), even if they can exert harmful pulmonary effects similar to some irritants that cause asthma or may represent allergens themselves (25, 26). Notably, the repeated inhalation of diacetyl, which gives vape the taste of butter/biscuits, has found to cause a bronchiolitis obliterans syndrome known as *pop-corn workers' lung* (27). The flavouring additives terpene and ethyl ester undergo decomposition after aerosolization with the production of reactive oxygen species and other chemical substances such as ketenes that induced lung damage even at low concentrations (28). Moreover, the heating and aerosolization at high temperatures of the e-liquids is associated with the degradation of other components and emission of potentially toxic and/or cancerogenic compounds such as carbonyl compounds (e.g., formaldehyde, acetaldehyde, and acetone), metals, and tobacco-specific nitrosamines (29), giving the aerosol a more complex chemical composition than the original e-liquid (**Table 3**). The aerosol generates particles of different sizes which allows their distribution in both the lower and upper airways (30, 31) and may cause inflammation on the respiratory mucosa (32-37). Also aerosol from HTP contains nicotine as well as many toxicants, some

Table 3. Main toxicant substances found in vape from e-cigarettes: even if the levels and numbers of substances are generally lower than those in smoke from conventional cigarettes, it is difficult to estimate the actual quantity of substances inhaled by the user, which depends on the device and related customization, vaping habits, composition of e-liquids, sticks or pod. Some of these toxicants have been found also in vape from heated tobacco products (13, 38).

Irritant/toxicant substances	Known carcinogens
Nicotine	Formaldehyde
Carbonyls	Butanone
Solvents (PG/VG)	Benzene
Flavourings	Acetaldehyde
Tobacco alkaloids	Benzopyrene
Tobacco specific nitrosamines	Acrolein
Volatile organic compounds	
Metals	
Microorganisms	
Carbon monoxide	Toluene
Tar	

of which are also found in traditional smoke, such as volatile organic compounds, polycyclic aromatic hydrocarbons, and carbon monoxide produced from pyrolysis and thermogenic degradation (38). It should be noted that HTP deliver at least 20 chemicals that are not present in CC and that could be toxic and harmful also (39).

ACUTE AND CHRONIC RESPIRATORY TOXICITY OF VAPING IN CHILDREN AND ADOLESCENTS

Health effects of acute and long-term exposure to vape from ENDS is currently being investigated. Some Authors reported that the acute lung toxicity of EC may be greater than that of CC and several studies have shown a concrete association between vaping and acute lung injury, current asthma, pulmonary haemorrhage and eosinophilic and lipoid pneumonia, even in adolescents (40, 41). A great concern was raised in 2019 after the spread of EVALI (*E-cigarette or Vaping use Associated Lung Injury*) among young adults and adolescents in the US, with 76% of the patients being <35 years of age and 15% <18 years of age, as reported by the Centers for Disease Control and Prevention (42). This condition includes non-specific symptoms such as shortness of breath, cough, fever and chills, vomiting and diarrhoea, headache, dizziness, and chest pain together with pulmonary opacities on radiography or CT and a history of vaping in previous 3 months, with no other causes (43-46): it should be noted that CT findings of EVALI show different degrees and stages of acute lung injury, with organizing pneumonia being the more common pattern (47). Notably, Corcoran *et al.* in their study reported seven EVALI cases in adolescents, five of which required supplemental and three of which showed reduced lung function after discharge despite resolution of symptoms, thus underlining the importance of respiratory follow-up for children and adolescents diagnosed with probable or confirmed EVALI (48). One case of EVALI was reported also in an Italian 15-year-old girl (49). The spread of EVALI seems to have been caused by vitamin E acetate, a substance used as a diluent and thickener in e-liquids containing tetrahydrocannabinol: unfortunately, when inhaled, vitamin E acetate interacts with phosphatidylcholine, altering surfactant and superficial tension, thus initiating alveolar inflammation (50, 51). However, vitamin E is not the only cause of EVALI, since more than 10%

of cases were reported in subjects who had used only ENDS products containing nicotine and no THC at all. In 2022, results from the PATH study (*Population Assessment of Tobacco and Health*) have shown that use of EC among healthy young adults is independently associated with the development of respiratory symptoms in general (52). As for children and adolescents, in the study by Zutrauen *et al.* 71 injury/illness cases of patients who presented to paediatricians for a harm related to the inhalation of vaping aerosols were analysed: 68% were aged 15 to 17 years; 54% presented with respiratory distress and 18% with symptoms of nicotine toxicity. Furthermore, the presence of respiratory distress was more likely associated with hospitalization or intensive care unit admission (53). Moreover, many studies on self-reported symptoms on adolescent vapers have been published: these are typically school-based data collections, mainly on high school students, which were carried out mostly in the United States but also in Asia and Canada. Taken together, these studies demonstrate increase odds of self-reported diagnosis of asthma by physicians and current asthma in the previous year in current EC users compared with never users, as well as increased odds of reporting asthma symptoms, chronic cough or phlegm, and/or bronchitis (54-59). In detail, the most reported respiratory symptoms are coughing, shortness of breath, throat irritation, chest pain, phlegm and wheezing (60, 61), and effects appear particularly prominent among individuals with a pre-existing history of bronchial asthma (62, 63). Some of these studies reported respiratory symptoms in adolescents exposed to second hand vaping at home. Notably, in 2022 Islam *et al.* demonstrated that second hand vape exposure was associated with increased risk of bronchitis symptoms and shortness of breath in a cohort of more than 2000 young participants (mean age 17,3 years) enrolled from schools in Southern California (64). It has been recently reported that second hand exposure to vaping can affect negatively asthma control in children (65). *In vivo* animal studies show potential also for third-hand exposure to vape (66). Even if studies are less numerous, acute lung injury and detrimental effect of second-hand exposure have been reported also for HTP (67-69).

The long-term effects of vaping exposure are still poorly known. However, there is already evidence on late onset

implications such as an increase in cardiopulmonary morbidities and potential detrimental effects in many other districts as well as increased risk of pulmonary, systemic and neoplastic illness in a similar way to CC (70, 71). Some studies have focused on the role of the single components of vape, demonstrating that vegetable glycerin, propylene glycol and flavourings are directly linked to lung function impairment (72). Additionally, it is well recognized the role of nicotine in increasing the permeability of primary lung microvascular endothelial cells, leading to the compromise of the endothelial cell barrier function (73). Moreover, molecular investigations underscore alterations in respiratory immune homeostasis attributed to chronic EC use, resulting in increased susceptibility to viral infections (74-77). It can be assumed that chronic, daily vape inhalation alters the inflammatory and immune status of the lungs, causing greater risk of infections and inflammatory disorders of the lungs, as well as significant decline in key spirometry parameters in vapers, but no data is available regarding childhood and adolescence (78). The cumulative effects in terms of oxidative stress, protease activity, inflammation, infection recurrency and DNA damage, collectively point to an elevated risk of asthma, COPD and lung cancer among EC users. This risk is corroborated by long-term exposure studies in mice, revealing the development of adenocarcinomas and bladder urothelial hyperplasia (79), nicotine-dependent airway changes comparable to cigarette-induced emphysema and COPD (80, 81), and persistent, widespread DNA damage in the lungs, heart, and bladder mucosa (82). Recently, in a case control study of 4975 lung cancer cases and 27294 controls without cancer, it was found that the risk of lung cancer among those who combined vaping with CC was 4-fold higher than for those who only smoked (83).

EFFECTS OF PRENATAL EXPOSURE TO VAPING

Women often think that the use of EC and HTP during pregnancy is harmless. A survey conducted in pregnant women showed that nearly 40% don't know that EC contain nicotine and 40-60% perceive them as safer than CC (84). Moreover, there are studies supporting the use of EC as a valuable option for pregnant smokers who cannot quit smoking (85). Nonetheless, most

authors as well as the World Health Organization warn against the risk of EC in pregnancy stating that no product containing nicotine is safe in pregnancy. So far, very little studies have been conducted in humans to evaluate the short and long-term effects of maternal vaping on offspring. A recent randomised control trial comparing EC and nicotine patches as strategies to quit tobacco smoking during pregnancy showed a similar safety profile of these products. However, it is important to highlight that the cessation rates were very low in both groups as a limitation (86). Nonetheless we need studies comparing EC with no tobacco-derived products to have reliable data on their safety. In this regard some recent data suggest that women vaping during pregnancy have a significantly higher risk of adverse perinatal outcomes, such as preterm birth (87, 88). Likewise, some recent studies suggested that also the use of HTP during pregnancy may be associated to preterm birth (89), low birth weight and hypertensive disorders of pregnancy (90). Moreover, a cross-sectional survey conducted in Japan showed an association between the use of HTP during pregnancy and an increased prevalence of allergy in the offspring (91). It should be noted that vaping can lead to blood nicotine levels like those associated with CC smoking (92): since animal studies proved that nicotine is the key mediator of the negative impact of in-utero tobacco smoke exposure on lung development, it is likely that similar detrimental effects can be caused by inhaling nicotine during pregnancy. Nicotine, in fact, affects offspring lung structure impairing alveolarization and reducing vessel density, and influences lung function causing a decrease in expiratory flow (93). Moreover, nicotine exposure during intrauterine life is associated with impaired function of alveolar macrophages and increased levels of oxidative stress (94). Furthermore, it should not be forgotten that exposure to vape during fetal life implies exposure to a mixture of other substances the effects of which on offspring are still largely unknown.

Studies in mouse models demonstrated that maternal vaping is associated with delayed embryo implantation, reduced birth weight, increased neurodevelopmental vulnerability and vascular dysfunction and can induce epigenetic reprogramming in offspring too (95, 96). As for the development of the lung, studies conducted in mice showed that intrauterine exposure to EC either

with or without nicotine can cause structural and functional lung abnormalities that persist into adulthood (97-99). At a molecular level, it has been demonstrated that EC vape exposure (with or without nicotine) leads to increased levels of factors associated with myogenesis and dysregulated extracellular matrix remodelling, processes that might predispose to chronic lung diseases later in life (100, 101). It has also been demonstrated that vaping exposure can lead to immune dysregulation in offspring persisting into adulthood (96). Finally, a recent study demonstrated that in utero mint-flavoured JUUL vaping exposure is associated with reduced offspring growth in a lamb model likely due to dysregulated expression of genes associated with hypoxia and oxidative stress which cause placental insufficiency. Moreover, increased lung inflammation in response to house dust mite was found, suggesting a possible association between maternal vaping and lifelong response to aeroallergens (102). In conclusion, although epidemiological studies on the effect on EC use during pregnancy on children's respiratory health are still scarce, considering the available evidence, it is mandatory that health care providers educate pregnant women about the risk associated with vaping (103).

VAPING USE IN CHILDHOOD AND ADOLESCENCE AND MARKETING STRATEGY OF ENDS

Despite being prosed as a smoking cessation device, a damage reduction strategy or a legal alternative where CC smoke is prohibited, EC have rapidly become the most common tobacco derived product used among youth (3-5, 104), with almost 5,9% of United States high school students currently vaping (5, 105) while in Europe, students as young as 11 years old tried EC at least once in 17 sites (106) and in Italy 20,2% of adolescents currently use EC and 14.3% currently use HTP (107). ENDS seem not to be a substitute for CC but rather a complementary product: almost all current smokers are triple users (CC + EC + HTP) or, sometimes, dual users (CC + EC) in this age group with a drastic increase of prevalence over the last two years. The reasons for this dramatic success must be sought in the widespread availability of ENDS together with their social acceptance and the attractive packaging of the products (108). Some of the products advertise their ability to be discreetly used: more than 60% of EC users declared to have *stealth*

vaped intended as used an EC in a public place where it was not approved and attempted to conceal EC use. Videos on the internet make demonstrate different techniques for producing vape by exhaling under clothing or into backpacks, often in the school setting (109). As expected, there is an association between social media use and increased risk of CC, EC, and dual use (109). Unfortunately, the adolescent brain is more susceptible to nicotine addiction: the effect is mediated by binding to the nicotine cholinergic receptor in the brain to release dopamine, which is involved in drug-induced reward and produces changes within the limbic and dopaminergic circuitry that underlies motivated behaviours, potentially enhancing the vulnerability to nicotine addiction (110). Therefore, adolescents may become easily addicted and may start also using CC (the *gateway effect*) (6). The main reasons for EC experimentation are curiosity, appealing flavours, and peer influences, while the top reasons for discontinuation were related to losing interest, perceiving EC as "uncool", and health concerns (111). Moreover, EC are perceived as less addictive and less harmful than CC and in adolescents. The worldwide spread of EC use is also due to aggressive marketing. Several studies have demonstrated the association between adolescent and young adults' exposure to EC marketing and their future vaping experimentation (112). EC companies base their marketing strategies on social media, working with celebrities and young influencers to promote their products with posts showing everyday activities and often concealing their commercial aim (113). Pricing strategies are also utilized by vaping industry to maintain existing customers but also to recruit new ones. Finally, social media is a powerful marketing tool because it lets companies learn about who interacts with their content and target consumers' specific demographic profiles (114). Another marketing tool that EC companies adopt is product placement in music videos that appear on popular platforms such as YouTube. This strategy that combines advertising and entertainment is known as "advertainment" and produces a positive attitude towards the product use (115, 116). Another strategy is the use of cartoon-based marketing to promote vape products, with many manufacturers using cartoons in their logo as a brand recognition strategy (117). The ENDS marketplace has also expanded in real shops, with thousands of new stores opening

in the last decade. These stores provide a social and interactive experience, where vape shop retailers act as consumer educators. Moreover, the store windows are designed to be colourful, attractive and eye-catching, showing price promotions, so even nonsmokers are exposed to vape products while walking about their daily activities. Vape shops and EC companies often sponsor social events where these devices can be tried for free, too, where branded merchandise is distributed to guests and there are often branded photos frames for taking pictures and selfies to post on social media. Marketing is also based on unproven and false claims. For instance, neither World Health Organization nor any scientific society have approved EC as a smoking cessation aid, EC companies still use smoking cessation as a marketing communication message. They also state that EC are cleaner and healthier because they don't produce second-hand smoke but only vapour, which is untrue. Health warnings are rare and written in small fonts, often placed at the bottom of the announce, within *terms and conditions*.

INTERVENTIONS FOR PREVENTING E-CIGARETTE USE AMONG CHILDREN AND ADOLESCENTS

Primary physicians' involvement is essential in screening, prevention and management of EC usage. Research from the US shows that in primary care settings, screening for vaping is not frequently undertaken: the most important reason is the lack of knowledge about ENDS and their risks (118), while awareness of the risk of EC in adolescents could increase through counselling actions by physicians. An important role should be given to the organization of public health education campaigns by institutions. Among the activities, it could be useful to distribute brochures to patients and their families on the health risks associated with vaping (119, 120). There are few data on the effectiveness of public health interventions. One trial demonstrated encouraging results from a text messaging campaign in the United States, and similar positive results have been seen in the past with text messaging aimed at smoking cessation (121). Moreover, EC apps dedicated to vaping cessation should be implemented since few are now available in contrast with many apps encouraging adolescent's EC use (122). Policy interventions should ban the use of cartoons and other strategies aimed at children and ado-

lescents as targets for EC marketing. In the last few years, the Food and Drug Administration issued warnings to companies regarding the advertising and distribution of EC young people, particularly through social media platforms (123) as well as to distribute ENDS resembling youth-appealing characters (124). The strict enforcement of bans on the sale of EC to minors and limiting their availability are essential as well as vaping in public places bans and stricter restrictions which are starting to be applied in many countries to face this new epidemic, together with increasing the minimum age of sale of EC and all tobacco products from 18 to 21. On the contrary, in other countries smoke-free laws were established before EC entered the market and therefore, they didn't mention EC at all (125).

CONCLUSIONS

The members of SIMRI's Task force on vaping, based on the current available evidence, acknowledge that ENDS represent a serious threat to respiratory health in children and adolescents and propose ten recommendations to take action, which are provided in **Table 2**. While limiting the spread of ENDS among children and adolescents seems very difficult, we believe that each pediatrician should screen for vaping and might contribute to educate parents and children on the subject. Schools and organization should also be involved, and it is desirable that more restrictive laws will be approved soon to reduce the places where to use ENDS. Our goal should be to pursue breathing clean air and preventing or stopping all tobacco and nicotine product use, and not to replace one harmful tobacco/nicotine product with another one.

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COMPLIANCE WITH ETHICAL STANDARDS

Conflict of interests

The Authors have no conflict of interests relevant to this article to disclose.

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Author contributions

MEDC, MG, SLG conceptualized the study, drafted the initial manuscript, reviewed the literature and critically revised the final manuscript. ABe, ABo, SC, MF, AK, CM, RN, DR contributed to the review of the literature and data collection and drafted parts of the initial manuscript. All authors proposed, discussed and approved the final ten recommendations. All authors read, critically reviewed and approved the final manu-

script as submitted and agree to be accountable for all aspects of the work.

Ethical approval

Human studies and subjects

N/A.

Animal studies

N/A.

Data sharing and data accessibility

Data are available upon motivated request to the Corresponding Author.

Publication ethics

Plagiarism

Authors declare no potentially overlapping publications with the content of this manuscript and all original studies are cited as appropriate.

Data falsification and fabrication

All the data correspond to the real.

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