Why and how should children be protected from the deluge of vaping related media and marketing overexposure?

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Vaping in children is rising, exposing them to significant harm. Aggressive marketing plus weak legislation increases the risks of children accessing vapes. We should introduce strong medical and legal protections to safeguard children. https://bit.ly/40j5QQQ

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Abstract

E-cigarettes are products delivering nicotine *via* inhalation and are devised to mimic tobacco smoking. While they were initially introduced as a device putatively to aid with smoking cessation, their use is now far broader than that. Use by children is significantly increasing. There is growing evidence of the potential harms of vaping. E-liquids used for e-cigarettes contain a wide range of harmful substances, and the clinical consequences of this are now being increasingly demonstrated, such as the rise in cases of e-cigarette- or vaping-associated lung injury. In addition, early use may result in long-term nicotine addiction. Vaping companies utilise marketing methods that distinctly target young people, and weak legislation in the UK allows them free rein to expose children to vaping.

In this review we demonstrate why children must be protected from vaping. We must have stringent legislation to prevent easy access to e-cigarettes, including banning the convenience and affordability disposable vapes provide, and prevent marketing that does not warn about the potential health effects. The Australia approach of prescription or pharmacy only access for smoking cessation should be considered to limit exposure of children and minimise use by nonsmokers.

Introduction

Electronic cigarettes (e-cigarettes) are electronic devices that mimic tobacco cigarettes and involve the inhalation of aerosols from e-liquids. These usually contain nicotine as well as a variety of other substances. These devices were initially promoted as a product that putatively would help tobacco smoking cessation, but use is now far broader than that. Vaping (or e-cigarette use) is significantly rising in young people, with 8.6% of those aged 11–18 years recorded as currently vaping in 2022 compared with 4% in 2021 in the UK. This is a higher percentage than those who use conventional smoking tobacco products (6%) [1]. There are many factors behind this rise, including aggressive conventional and social media marketing from vaping companies, and light touch regulation of these products resulting in difficulty restricting access to under 18-year-olds. This contrasts with the successful attempt to decrease use of tobacco cigarettes in children and young adults over the past few decades *via* ensuring health risks are highlighted, restricting advertising, banning use in public spaces and limiting visual marketing and access in shops. This has led to substantial long-term health benefits, including reducing asthma attacks, myocardial infarction and the prevalence of low birth weight [2–4]. A highly lucrative industry is incentivised to maximise profits by taking advantage of any marketing possibilities available to them, and to lobby governments to further optimise these opportunities and prevent restrictions.

This has recently been recognised by the UK Chief Medical Officer, Chris Whitty, who highlighted reducing vaping in young people as an important public health priority, and by the Director General of the World

Health Organization, Tedros Adhanom Ghebreyesus, who called vaping a "trap" concocted by the tobacco industry, recruiting children as e-cigarette users who may later become nicotine addicts [5, 6]. However, this contrasts with the promotional approach elsewhere in the UK towards vaping. Public Health England repeatedly cite on government documents that vaping is "at least 95% less harmful than tobacco smoking". This is then often repeated by the mainstream media. However, this statement was based on expert opinion from a multi-criteria decision analysis, and not on empirical data. Furthermore, the paper concludes that the evidence from this analysis was insufficient to reach robust conclusions [7]. There is a thorough rebuttal of this selective approach to the evidence in a *Lancet* editorial from 2015 [8]. Despite this, Public Health England use this factoid to promote vaping to the public as safer than tobacco cigarettes.

There is increasing evidence of the multiple harms associated with vaping, including acute lung and neurological toxicity, burns and blast injuries from combustion of the devices, effects on brain development and academic performance, and second-hand exposure alongside unknown long-term effects. E-cigarette- or vaping-associated lung injury (EVALI) is an increasingly recognised severe disease with diverse pathologies that affected 2807 patients with 68 deaths in the USA up to 2020 [9].

Given this context, we present this review to highlight why it is vital we protect children from the risks of vaping, and how best to do this.

Vaping-related harms

The majority of vaping products contain nicotine. We know that nicotine is a highly addictive substance, with significant withdrawal symptoms present on cessation after only brief use. It also affects brain development which is a particular concern in children and adolescents [10]. There is evidence that nicotine or e-cigarette use can cause poorer academic performance, cognitive impairments later in life, increased risk of mental health issues and can lead to lifelong addiction. There is also evidence of an association with cardiovascular and tumour promoting side-effects, although these have not been demonstrated clinically in humans due to a lack of long-term data [11, 12]. Thus, the high concentrations of nicotine in some vaping products is worrying. Both Juul and Elf Bar, the most popular vaping brands in both the USA and the UK, sell their products with nicotine concentrations of 20 mg. This is equivalent to smoking 20 tobacco cigarettes in one disposable e-cigarette. On top of this, some e-cigarettes have been found to contain 50% more e-liquid than stated, and therefore, even higher amounts of nicotine. This has resulted in increasing numbers of teenage vapers. There is evidence that the dependence on these products is similar to tobacco cigarettes, and that use of these products was actually associated with an increase in use of cigarettes [13–16]. Even though there is no evidence that suggests that being addicted to nicotine as a child or young person is more difficult or resistant to treat, there is substantial evidence that young nicotine addicts may have an increased risk of becoming tobacco smokers or having high ethanol use or use recreational drugs. Unlike the very widely advertised services that promote vaping as a tool to quit smoking, the availability of a service to quit vaping is not widely known or promoted [17].

If e-cigarettes contained only nicotine, they would be hazardous; however, e-liquids also contain a host of other harmful constituents. They generally contain a liquid solvent to dissolve the nicotine and flavourings, other additives, such as flavourings or colourants, and some liquids contain trace chemicals from nicotine extraction and adulterants such as bacterial or fungal products. In many cases there is no evidence to demonstrate the wide range of ingredients present are safe. An evaluation of the most popular vaping products in the European Union (EU) revealed that all 122 contained additives that presented some risk of hazard. The majority of these were respiratory irritants, but there were also a variety of other effects including skin and eye irritation, drowsiness or dizziness, potential fetotoxicity, and flammability. This was a random sampling of e-liquids, and therefore may have missed further toxic additives. It is difficult to know what the cumulative effects of these combined respiratory irritants and other toxins may produce [18]. Also of note, the temperature used to ignite the e-liquid varies, and there have been some examples of burns or blast injuries from vaping devices [19].

The clinical effects of vaping on people are becoming better understood, with expanding literature on associated symptoms or conditions. The best known of these is EVALI. EVALI commonly presents as nonspecific respiratory symptoms (such as cough, dyspnoea and chest pain) often with associated gastrointestinal symptoms, fever, chills and weight loss. However, the syndrome may be severe with catastrophic respiratory failure as a result of a potent inflammatory response to the e-liquid [20]. It is a diagnosis of exclusion, which requires a history of vaping, the absence of other possible microbiological or other pathological causes, and radiological evidence consistent with EVALI [9, 18]. Most cases of this condition have been seen in the USA [9], but there is increasing reporting from the rest of the world. Up to January 2020, the UK Medicines and Healthcare products Regulatory Agency (MHRA) received reports of

182 respiratory events in the UK related to vaping, with four resulting in fatal outcomes [21]. The presentation, radiological findings, clinical course and pathophysiology and histopathology for EVALI is diverse. The condition can be severe, requiring intensive care and in some cases extracorporeal membrane oxygen [9, 18, 20, 22]. A systematic review has correlated animal and mechanistic studies with human data, and has not identified a single cause, concluding that the condition is likely multifactorial with exogenous and endogenous factors playing a role [22], which, given the many disparate manifestations of EVALI, is biologically plausible. The serious nature of this condition should be considered in the context of tobacco cigarettes not causing any similar acute pathology.

There are also a wide range of other effects of vaping on the human body. Tzortzi *et al.* [23] found many adverse health effects from vaping outside of the respiratory system. The most relevant for the purposes of this review were poisonings (accidental ingestion in young children, intentional in young adults), which included fatal cases, and cases where vaping affected metabolism of anti-epileptic drugs resulting in increased seizure frequency in adolescents and young adults. Other effects included allergy, skin conditions and coronary events [23].

There is limited evidence, to date, of the long-term effects of vaping, although given what we have already demonstrated there should be strong concerns about its long-term safety considering the harmful substances present in e-liquids (and it should be recalled that it took decades before it was confirmed that smoking caused lung cancer; during that time, the tobacco industry, who now market vapes, concealed data and minimised risk). Although limited, some research does suggest a risk of long-term harm from vaping. There have been some cases identified with chronic lung disease with small airway fibrosis secondary to long-term vaping (3–8 years). There was symptomatic and objective improvement in those patients who stopped vaping after this, but they did not return to their baseline. One of these patients was using e-cigarettes without known additives such as nicotine, tetrahydrocannabinol (THC) or flavourings. This raises the possibility of a cohort of e-cigarette users being diagnosed with only partially reversible chronic lung disease manifestations in the future [24].

A review of preclinical and human studies showed that the drug reward effects of nicotine from vaping at a young age are associated with increased numbers going on to use tobacco cigarettes, and could increase the risk of excess ethanol ingestion and recreational drug use [23]. This review also supports the concerns raised in studies already mentioned regarding long-term academic performance and cognition, and poorer mental health [11, 12]. Therefore, we must carefully consider the dangers of creating future generations of nicotine users and addicts because they were exposed to vaping at a young age.

There is also some evidence that second-hand exposure may be harmful, with an association with higher odds of asthma exacerbations in 11–17-year-olds [25]. One case study reported hypersensitivity pneumonitis caused by second-hand exposure because the subject's partner used e-cigarettes at home [26]. Another paper using parental interviews indicated that parents were less concerned about exposing their children to e-cigarette aerosols at home or in their cars compared with tobacco smoke, particularly for dual users [27]. Therefore, children could be at a higher risk of second-hand exposure and harms from vaping compared with tobacco smoke.

It is vital that as clinicians we consider vaping in a social history to correlate with symptoms, signs or conditions presenting in patients. Public health bodies should collate this information and research should be undertaken to build an evidence base for the long-term effects of vaping.

While outside the scope of this review, we would also regard heated tobacco products in a similar way as a risk for introducing children and young people to nicotine. Current use in the UK and Europe is very rare, but we should be wary of the tobacco industry (which also funds this technology and most research carried out regarding the products) switching focus to marketing these products if vaping is more strongly regulated, without current good evidence of harm reduction compared with tobacco smoking [28, 29].

Figure 1 illustrates the variety of different harms vaping can cause.

Use and legal status of e-cigarettes

E-cigarettes were initially promoted as an alternative to tobacco cigarettes to aid in smoking cessation, and this remains the main reason for support for the use of vaping products. No one disputes the morbidity and premature mortality caused by tobacco smoke. However, the evidence for the efficacy of vapes in smoking cessation remains limited. A recent systematic review and meta-analysis of cohort studies and randomised controlled trials found no quality evidence for an association between e-cigarette use and smoking

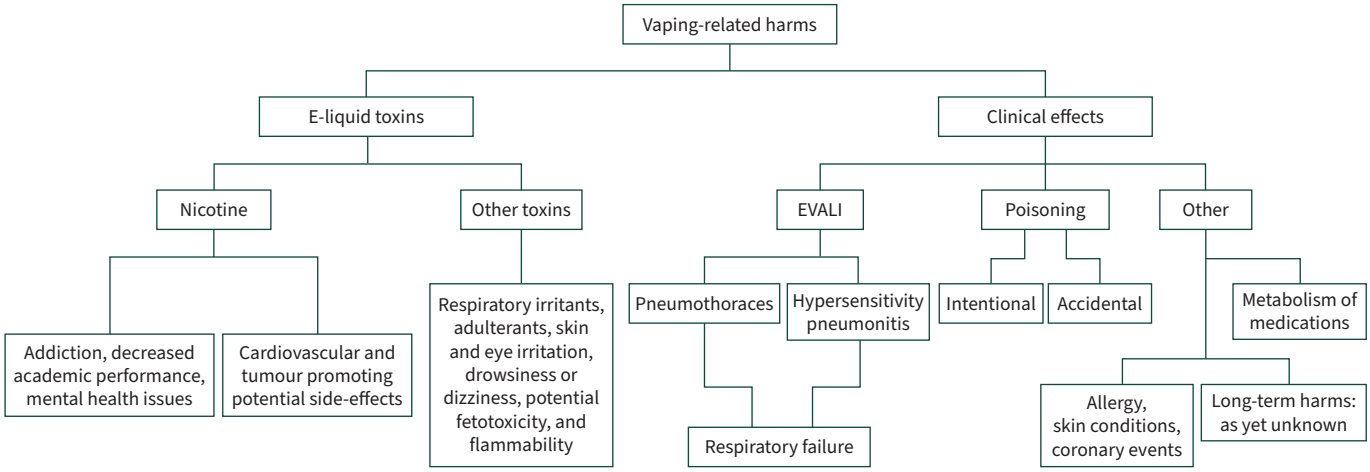

FIGURE 1 A summary of vaping-related harms. EVALI: e-cigarette- or vaping-associated lung injury.

cessation. Although the randomised controlled trials in this analysis showed more of a positive association, this only applied to those aged over 18 years. In addition, in most of the trials, participants were recruited directly from smoking cessation services and therefore were motivated to quit already and had support to aid their smoking cessation. This is hardly generalisable to real world use of vaping products in tobacco smokers. The authors also noted the risks of bias were high in all of these trials [27]. This contrasts with the good evidence available for conventional smoking cessation programmes that include both behavioural and pharmacological interventions, supported by meta-analyses [30–32]. There is also evidence from a Cochrane systematic review and meta-analysis that the behavioural component available in smoking cessation services itself adds clinical effectiveness in smoking cessation [33]. There should be concern about the way in which vaping is mostly used as a smoking cessation tool, often with informal purchasing and no support or follow-up to aid in the cessation process. This also increases the risk of dual use, which is concerning in its exposure to the potential harms of both tobacco cigarettes and e-cigarettes [34]. Despite all this, funding for formal smoking cessation services is being cut, encouraging the public to instead choose vaping informally without education or support [35].

The current legal status of e-cigarettes is that sale is limited to those over the age of 18 years only. However, they are mostly not treated the same as tobacco cigarettes, allowing extra promotional opportunities and avoiding highlighting of risks. We could not find any evidence that any regulatory agency has approved e-cigarettes for smoking cessation. The MHRA, working with other regulatory bodies, is responsible for implementing a number of provisions under the Tobacco and Related Products Regulations 2016 (TRPR) in the UK, which ensure:

- minimum standards for the safety and quality of all e-cigarettes and refill containers (otherwise known as e-liquids);
- that information is provided to consumers so that they can make informed choices; and
- an environment that protects children from starting to use these products.

However, this is not a regulatory approval for use of e-cigarettes for smoking cessation [36].

This prioritisation of vaping products to try to aid smoking cessation with relatively free access, comes at the cost of exposing children and adolescents to vaping products. In the UK, in particular, and across various EU countries, the regulations are far weaker than in some other jurisdictions. In Australia, legislation has recently been passed requiring that e-cigarettes are a prescription only product, only available as a smoking cessation support. In New Zealand, Japan, Turkey and South Korea vaping is banned in public places, there are tight controls over advertising and there is increased taxation and education around vaping [37]. In addition, the USA has introduced Tobacco 21 legislation which makes it illegal to sell tobacco products, including e-cigarettes, to those under 21 years of age, which comparatively better protects young people [38].

The Forum of International Respiratory Societies has made recommendations to protect youth from nicotine in e-cigarettes (see table 1) [39]. Accumulating evidence of immediate and medium-term harms

TABLE 1 Forum of International Respiratory Societies recommendations to protect youth from nicotine in e-cigarettes

1) To protect youths, electronic nicotine delivery systems should be considered tobacco products and regulated as such, including taxation of electronic cigarettes and supplies. The addictive power of nicotine and its adverse effects in youths should not be underestimated.
2) Considering the susceptibility of the developing brain to nicotine addiction, the sale of electronic cigarettes to adolescents and young adults must be prohibited by all nations, and those bans must be enforced.
3) All forms of promotion must be regulated and advertising of electronic cigarettes in media that are accessible to youths should cease.
4) Because flavourings increase rates of youth initiation, they should be banned in electronic nicotine delivery products.
5) As electronic cigarette vapour exposes nonusers to nicotine and other harmful chemicals, use should be prohibited in indoor locations, public parks, and places where children and youths are present.
6) While their health risks are increasingly recognised, more research is needed to understand the physiological and deleterious effects of electronic cigarettes.
7) Routine surveillance and surveys concerning combustible and electronic cigarette use should be carried out in many settings to better understand the scope and health threat of tobacco products to youths in different countries and regions.

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from use of e-cigarettes increasingly render the last two recommendations superfluous, but ongoing surveillance is absolutely necessary.

Acquisition of vaping products is made particularly easy by regulations that allow sales not only from specialised vaping retail shops appearing on high streets, but also online. There are also multiple loopholes in the current UK legislation that allow companies to give out free vaping samples to individuals under the age of 18 years and sell nicotine-free vaping products to those under 18 years of age [7]. It is very concerning that very young children are getting access to e-cigarettes, with recent NHS England data showing 15 cases of children under 9 years of age being admitted to hospital with vaping-related pathology [40].

How children and young people are exposed to vaping

All of this conspires to allow the vaping industry to target their advertising at children and adolescents, in a similar move to the approach taken by tobacco companies for decades until curtailed by legislation, to produce long-term users through addiction to nicotine. The freedom to promote vaping products aggressively allows the industry to use bright coloured packaging to visually attract young people. There are no restrictions on the use of flavourings, in contrast to cigarettes where flavourings are restricted (most countries only allow menthol flavour and even this is not legal in some countries). Some e-cigarettes are promoted in confectionery flavours that are designed to appeal to young people whilst appearing relatively harmless. Surveys have indicated high proportions of users state flavour as a main reason behind their vaping. In addition, disposable vaping products are easily available, convenient and relatively cheap. The opportunity to access these products online is both convenient, and negates age checks for individuals under 18 years of age. Retail shops are also less likely to check identification and verify age than for tobacco cigarettes. These combined factors target younger people and would rightly not be permitted for tobacco products [18, 41–43].

Vaping companies spend most of their marketing budget on magazine and television advertising. Unlike tobacco smoking, there are no limits on the timing or nature of radio or television adverts, including restriction around age-related content such as cartoons. Analysis showed that more than half of vaping adverts in the USA included features to appeal to youth, such as animation, content related to positive sensations, young actors, humour, promoting mood and individuality. This study also showed the significant budgets the industry uses for marketing, one brand alone (Juul) spent over USD 100 million in 2019 [44]. Although the restrictions on television and radio advertising in the UK and EU are much stronger and would prevent this kind of advertising legally, this shows the importance of targeting the youth market to these companies.

Vaping companies also advertise in ways that reach children and young people by associating with popular and positively viewed teams, sports or events. The most significant example of this is the sponsorship of

one of the biggest football clubs in the world, Paris Saint-Germain, by a vaping company. This is a club with worldwide awareness and following, and the deal to run television campaigns together and launch co-branded merchandise will extend to a significant audience of children and young people following Paris Saint-Germain, their favourite players, and key matches in highly viewed competitions. Additionally, in the UK the vaping brand "Totally Wicked" have become the main shirt sponsor for Blackburn Rovers (a Championship football team), which will mean many children will wear replica shirts bearing this company's brand. The same vaping company has also sponsored St Helens Rugby club to name their stadium after the brand. Multiple Scottish premier league football teams have been sponsored by vaping companies. Politicians have criticised this and highlighted that it would not be allowed or tolerated for a tobacco company to do the same. In addition, vaping companies have also sponsored other events favoured by young people such as music festivals and e-sports gaming [45–47].

Another flagrant marketing ploy by the industry is the use of college scholarships. These can offer up to USD 5000 to prospective students, and examples include submitting essays describing the potential benefits of vaping. Many of these scholarships are open to individuals under 18 years of age [48].

In addition, there is an increasing opportunity for the vaping industry to market their products directly in a cost-effective and uniquely attractive way to young people *via* social media. This includes direct marketing from the companies own accounts, broadcasting of offers or new products, and endorsements from other accounts. There is evidence of marketing across different sites including Facebook, Twitter, Instagram and Google+, all of which have numerous users who are under 18 years of age. They can use celebrities or influencers to advertise their brands. Studies have found that most assertions for e-cigarette benefits were not substantiated, and that posts on Twitter intended as jokes framed vaping as an attractive, relatively harmless and fun activity. There is evidence that children and adolescents are particularly vulnerable to social motives. Therefore, the industry uses these platforms to develop positive social norms around their products, increasing the likelihood of this population taking up vaping [49, 50].

Furthermore, even when attempts have been made to regulate social media marketing, it has been difficult to maintain compliance with these regulations. In the UK, despite some efforts to restrict social media marketing to children, companies continue to disregard this. One vaping company has been found to send free products to social media influencers, who then post videos on TikTok trying new flavours (such as "Rainbow Candy" and "Bubblegum") and expressing favourable views about these products without any age restrictions or health warnings, and minimal display that this is advertising [15]. In the USA, the Food and Drug administration introduced provisions requiring nicotine addiction warnings be placed on advertisements for vaping products containing nicotine, including those on social media. However, a study looking at the presence of these warnings on Instagram, found that before these provisions were introduced, warnings were absent from all Instagram posts promoting vaping. After the provisions were put in place, only 36.4% of US-based posts contained the warnings. To demonstrate the difficulty with these kinds of regulations, the authors also noted that on all the posts they analysed, the promotional posts originating in the USA dropped from 38% to 27.9%, with a large increase in posts from elsewhere (for example, Europe went from 20.8% to 29.2%). These posts from outside the USA, whilst visible to US users, were not subject to the regulations, so did not carry the nicotine addiction warnings. Therefore, the overall percentage complying with the provisions dropped to 13.6% [51].

In the USA, there is an example of the extent of aggressive marketing towards children with the case of Juul (as already mentioned, the most popular brand in the USA, and one that spends hundreds of millions on marketing). A 2-year investigation found the company had illegally targeted those under 18 years of age, leading to a legal settlement for USD 438 million. The tactics used by the company included all of the marketing methods described previously, and also spokespeople attending school events to advertise their products, describing vaping as "totally harmless" [52]. This illustrates the challenges with social media marketing regulations, and why both a global approach, and close monitoring and enforcement is needed for this sort of legislation.

The public are led to trust vaping as a less harmful and officially supported product by the associations the industry makes. For example, at the Smoking Cessation and Health Conference UK 2023 there were multiple speakers supporting vaping, including people encouraging swapping tobacco cigarettes for vaping during pregnancy, and even an area retail manager for a vaping company [53]. A local council is another example of lending respectability to vaping, in this case by offering free e-cigarettes to pregnant women [54]. This is despite there being no real evidence that vaping is safe in pregnancy, and in fact the existing evidence that the mechanism of harms to fetuses from tobacco smoking is not only nicotine mediated, but at least in animal experiments, also related to flavourings. Therefore, e-cigarettes

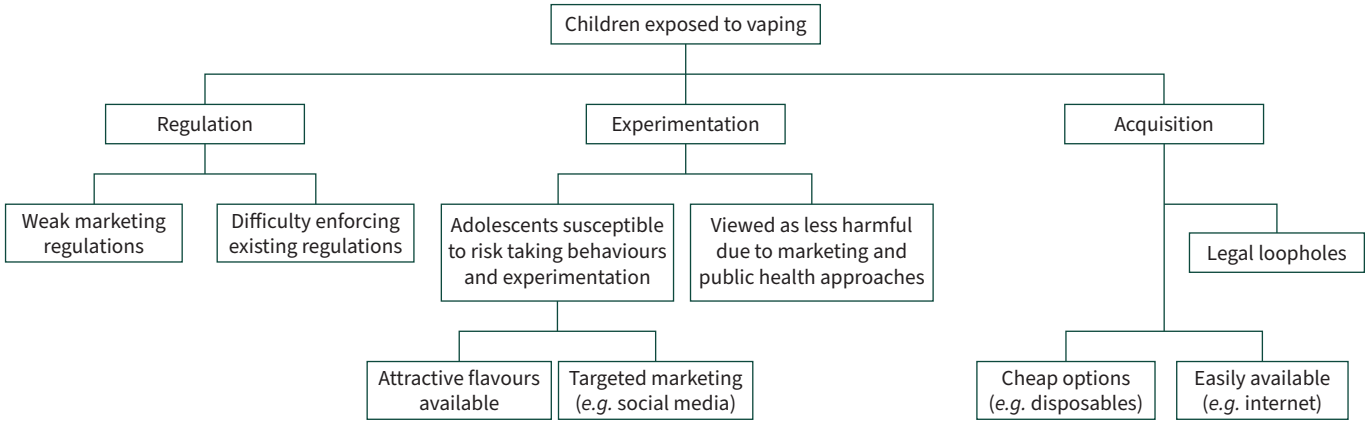

FIGURE 2 A summary of how children are exposed to vaping.

may lead to the same harms, and even encourage higher nicotine intake due to high-strength vapes or dual use with tobacco products [55–58]. The effect of this is to allow further cultural acceptance of vaping as less harmful and more acceptable than tobacco product use when the evidence suggests this is not correct.

The reason the vaping industry spends so much and is so aggressive with their marketing is twofold. First, it is because they can get away with it because of the unclear and diluted regulations, as discussed earlier. Second, it is because it works. Chen-Sankey *et al.* [59] demonstrated that, in those under 18 years of age who had never smoked, after 70.7% of the study cohort reported being exposed to e-cigarette marketing, 4.9% experimented with using vaping products. There was a statistically significant relationship between exposure to marketing and experimenting with vaping. In the under 18-year-olds who reported exposure, 60.6% reported exposure from television adverts, 60.3% from posters or billboards, 56.5% from websites or social media, and 55.9% from newspapers or magazines. A smaller proportion were exposed to marketing *via* radio or events (such as fairs or festivals). This illustrates the breadth of different media the vaping industry is using to aggressively target potential vapers, and the reach this is achieving to children and adolescents.

Figure 2 demonstrates a model of how children are exposed to vaping.

Conclusion

We have reviewed the harms of vaping products in the young and summarised the weak legislation and strong marketing strategies exploited by the vaping companies. The vaping industry has been allowed a free rein to market, promote and sell their products in a way that is not proportionate to the potential harms. Furthermore, marketing methods and easy availability of vaping products target young people, resulting in children experimenting with vaping. With the addictive nature of the nicotine in e-cigarettes, this could lead to a cohort of lifelong vapers who may have never smoked cigarettes. Further services may need to be put in place to help support these addicted children and young adults if we cannot protect this generation of potential targets for the vaping industry. We advocate for a similar approach to Australia, in terms of e-cigarettes being available under smoking cessation programmes only *via* prescription or a pharmacy, with follow-up and behavioural support available, and also consideration of increasing the legal age for obtaining all tobacco products including e-cigarettes to 21 years, as was done in the USA. At a minimum, e-cigarettes should have the same regulations as tobacco products. This would include plain packaging with nicotine and/or general harm warnings. The available flavours should be limited to nicotine and menthol to reduce attractiveness to young people. Vaping should be banned in public places, both to discourage use and prevent second-hand exposure. Strict marketing and advertising restrictions should be in place, to minimise exposure to younger people and ensure that where marketing is present the potential harms are clearly indicated. There should also be similar levels of taxation to tobacco products, and education so that the public are more aware of the risks. We would also encourage healthcare professionals to take every opportunity to inform children and young people and those they have contact with about the potential harms of e-cigarette use.

Key points

- Public Health England and the vaping industry promote e-cigarettes as a safe alternative to conventional cigarettes.
- However, there are multiple harms caused by the inhalation of hazardous substances contained in the e-liquids, particularly EVALI, with the long-term effects of vaping yet to be understood.
- Access to e-cigarettes is easy in the UK and Europe compared with international comparators.
- Vaping companies target children and young people with aggressive marketing *via* conventional promotions, social media and sponsorships.
- We must protect young people by using prescription or pharmacy only access to these products limited to smoking cessation programmes, and as a minimum put in place stringent regulations on e-cigarettes similar to those for tobacco products.

Self-evaluation questions

1. Public Health England promotes vaping as "at least" what percentage "less harmful than conventional cigarettes"?
   a) 20%
   b) 50%
   c) 75%
   d) 95%
2. One Juul pod or Elf Bar disposable e-cigarette delivers as much nicotine as how many conventional cigarettes?
   a) 1
   b) 2
   c) 5
   d) 10
   e) 20
3. There is currently no evidence for which of the following effects of substances contained in e-liquids?
   a) Poorer academic performance
   b) Insulin resistance
   c) Respiratory irritation and inflammation
   d) Asthma exacerbations from second-hand exposure
   e) Hypersensitivity pneumonitis from second-hand exposure
4. Which of the marketing methods listed below have not been used by vaping companies to target young people?
   a) Use of cartoons in television promotions
   b) Flavourings such as Cherry Cola, Rainbow Candy and Tropical Bomb
   c) Vaping employees attending school events to promote their products
   d) Endorsed in UK school curricula taught to school children
   e) *Via* influencers on social media

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References

1 Public Health England. Nicotine vaping in England: 2022 evidence update main findings. Date last accessed: 20 July 2023. Date last updated: 29 September 2022. www.gov.uk/government/publications/nicotine-vaping-in-england-2022-evidence-update/nicotine-vaping-in-england-2022-evidence-update-main-findings#smoking-and-vaping-prevalence

2 Cox B, Martens E, Nemery B, *et al.* Impact of a stepwise introduction of smoke-free legislation on the rate of preterm births: analysis of routinely collected birth data. *BMJ* 2013; 346: f441.

3 Mackay D, Haw S, Ayres J, *et al.* Smoke-free legislation and hospitalizations for childhood asthma. *N Engl J Med* 2010; 363: 1139–1145.
4 Mackay DF, Pell JP. Ten-year follow-up of the impact of Scottish smoke-free legislation on acute myocardial infarction. *Circ Cardiovasc Qual Outcomes* 2019; 12: e005392.
5 Department of Health and Social Care. No more free vapes for kids. Date last accessed: 20 July 2023. Date last updated: 31 May 2023. www.gov.uk/government/news/no-more-free-vapes-for-kids
6 Health Policy Watch. E-cigarettes Are a 'Trap' to Recruit Children Not Harm Reduction – Tedros. Date last accessed: 28 September 2023. Date last updated: 2 June 2023. https://healthpolicy-watch.news/e-cigarettes-are-a-trap-to-recruit-children-not-harm-reduction-tedros/
7 Nutt D, Phillips L, Balfour D, *et al.* Estimating the harms of nicotine-containing products using the MCDA approach. *Eur Addict Res* 2014; 20: 218–225.
8 E-cigarettes: Public Health England's evidence-based confusion. *Lancet* 2015; 386: 829.
9 CDC Web Archive. Outbreak of Lung Injury Associated with the Use of E-Cigarette, or Vaping, Products. Date last accessed: 20 July 2023. Date last updated: 25 February 2020. www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease.html
10 Leslie FM. Unique, long-term effects of nicotine on adolescent brain. *Pharmacol Biochem Behav* 2020; 197: 173010.
11 Royal College of Physicians. Nicotine without Smoke: Tobacco Harm Reduction. London, RCP, 2016.
12 Rondael JT. Academic Performance and E-cigarette Use Among Teenagers. DrPH thesis. Minneapolis, Walden University, 2023.
13 Pierce JP, Leas EC, Strong DR. Biochemical validation of dependence on JUUL and other E-cigarettes among youth. *Pediatrics* 2023; 151: e2022059158.
14 Pierce JP, Zhang J, Crotty Alexander LE, *et al.* Daily E-cigarette use and the surge in JUUL sales: 2017-2019. *Pediatrics* 2022; 149: e2021055379.
15 Das S, Ungoed-Thomas J. Chinese vaping giant flouting UK advertising rules on selling to children. Date last accessed: 23 July 2023. Date last updated: 17 July 2022. www.theguardian.com/society/2022/jul/17/chinese-vaping-giant-flouting-uk-advertising-rules-on-selling-to-children
16 Tobacco Reporter. Elf bar exceeds legal U.K. e-liquid volumes. Date last accessed: 5 August 2023. Date last updated: 6 February 2023. https://tobaccoreporter.com/2023/02/06/elf-bar-exceeds-legal-nicotine-limit/
17 NHS UK website. Vaping to quit smoking. Date last accessed: 3 October 2023. https://www.nhs.uk/better-health/quit-smoking/vaping-to-quit-smoking/#quitvaping
18 Vardavas C, Girvalaki C, Vardavas A, *et al.* Respiratory irritants in e-cigarette refill liquids across nine European countries: a threat to respiratory health? *Eur Respir J* 2017; 50: 1701698.
19 Bhatt J, Ramphul M, Bush A. An update on controversies in e-cigarettes. *Paediatr Respir Rev* 2020; 36: 75–86.
20 Gupta V, Hayes D, Hsu S, *et al.* Extracorporeal life support for respiratory failure in patients with electronic cigarette or vaping product use-associated lung injury. *Crit Care Med* 2022; 50: e173–e182.
21 MHRA. E-cigarette use or vaping: reporting suspected adverse reactions, including lung injury. Date last accessed: 25 July 2023. Date last updated: 27 January 2020. www.gov.uk/drug-safety-update/e-cigarette-use-or-vaping-reporting-suspected-adverse-reactions-including-lung-injury
22 Jonas A, Raj R. Vaping-related acute parenchymal lung injury: a systematic review. *Chest* 2020; 158: 1555–1565.
23 Tzortzi A, Kapetanstrataki M, Evangelopoulou V, *et al.* A systematic literature review of E-cigarette-related illness and injury: not just for the respirologist. *Int J Environ Res Public Health* 2020; 17: 2248.
24 Hariri LP, Flashner BM, Kanarek DJ, *et al.* E-cigarette use, small airway fibrosis, and constrictive bronchiolitis. *NEJM Evid* 2022; 1: 10.1056/evidoa2100051.
25 Bayly J, Bernat D, Porter L, *et al.* Secondhand exposure to aerosols from electronic nicotine delivery systems and asthma exacerbations among youth with asthma. *Chest* 2019; 155: 88–93.
26 Galiatsatos P, Gomez E, Lin C, *et al.* Secondhand smoke from electronic cigarette resulting in hypersensitivity pneumonitis. *BMJ Case Rep* 2020; 13: e233381.
27 Drehmer JE, Nabi-Burza E, Hipple Walters B, *et al*. Parental smoking and e-cigarette use in homes and cars. *Pediatrics* 2019; 143: e20183249.
28 McNeill A, Brose LS, Calder R, *et al.* Evidence review of e-cigarettes and heated tobacco products 2018. A report commissioned by Public Health England. London, Public Health England, 2018.
29 Mallock N, Pieper E, Hutzler C, *et al.* Heated tobacco products: a review of current knowledge and initial assessments. *Front Public Health* 2019; 7: 287.
30 Hedman L, Galanti M, Ryk L, *et al.* Electronic cigarette use and smoking cessation in cohort studies and randomised trials: a systematic review and meta-analysis. *Tob Prev Cessation* 2021; 7: 62.
31 Patnode C, Henderson J, Coppola E, *et al.* Interventions for tobacco cessation in adults, including pregnant persons: updated evidence report and systematic review for the US preventive services task force. *JAMA* 2021; 325: 280–298.

32 Saba M, Diep J, Saini B, *et al.* Meta-analysis of the effectiveness of smoking cessation interventions in community pharmacy. *J Clin Pharm Ther* 2014; 39: 240–247.
33 Stead L, Koilpillai P, Lancaster T. Additional behavioural support as an adjunct to pharmacotherapy for smoking cessation. *Cochrane Database Syst Rev* 2015; 10: CD009670.
34 Byrne S, Brindal E, Williams G, *et al.* E-cigarettes, smoking and health. A literature review update. Australia, CSIRO, 2018.
35 Nolan T. Tom Nolan's research reviews. *BMJ* 2023; 382: p2206.
36 Medicines and Healthcare products Regulatory Agency. Guidance. E-cigarettes: regulations for consumer products. Date last accessed: 3 October 2023. Date last updated: 2 November 2022. www.gov.uk/guidance/e-cigarettes-regulations-for-consumer-products
37 Macleod K, Bush A, Coutts J, *et al.* Protecting children from harms of vaping. *BMJ* 2022; 379: e073824.
38 US Food and Drug administration. Tobacco 21. Date last accessed: 28 September 2023. Date last updated: 9 January 2021. www.fda.gov/tobacco-products/retail-sales-tobacco-products/tobacco-21
39 Ferkol T, Farber H, La Grutta S, *et al.* Electronic cigarette use in youths: a position statement of the Forum of International Respiratory Societies. *Eur Respir J* 2018; 51: 1800278.
40 Birchley E. E-cigarettes: Primary school age children are ending up in hospital due to excessive vaping. Date last accessed: 3 August 2023. Date last updated: 25 June 2023. https://news.sky.com/story/e-cigarettes-primary-school-age-children-are-ending-up-in-hospital-due-to-excessive-vaping-12909116
41 Monaghan K. When lightning strikes twice: E-cigarette's use of traditional cigarette marketing practices. *Seton Hall Legis J* 2021; 45: 6.
42 Gendall P, Hoek J. Role of flavours in vaping uptake and cessation among New Zealand smokers and non-smokers: a cross-sectional study. *Tob Control* 2021; 30: 108–110.
43 Coutts J, Langley R. Toxic and addictive effects of nicotine on children and adolescents: are we sleepwalking into a public health disaster? *Arch Dis Child* 2023; 108: 691–692.
44 Hoetger C, Wall C, Rudy A, *et al.* Content Appealing to youth and spend characteristics of electronic cigarette video advertisements. *J Public Health (Oxf)* 2022; 44: 129–137.
45 SportsPro. PSG become first soccer club to agree vape brand partnership. Date last accessed: 23 July 2023. Date last updated: 27 July 2021. www.sportspromedia.com/news/psg-vape-brand-geekvape-sponsor-2021-autohero/?zephr_sso_ott=vZtIB2
46 BBC news. MPs criticise Blackburn Rovers Vaping sponsorship deal. Date last accessed: 23 July 2023. Date last updated: 13 July 2023. www.bbc.co.uk/news/uk-england-lancashire-66183944
47 Scottish Government. Vaping products - tightening rules on advertising and promoting: consultation analysis. Date last accessed: 23 July 2023. Date last updated: 27 September 2022. www.gov.scot/publications/tightening-rules-advertising-promoting-vaping-products/pages/7/
48 Truth Initiative. 4 marketing tactics e-cigarette companies use to target youth. Date last accessed: 25 July 2023. Date last updated: 9 August 2018. https://truthinitiative.org/research-resources/tobacco-industry-marketing/4-marketing-tactics-e-cigarette-companies-use-target
49 Chu K-H, Sidhu A, Valente T. Electronic cigarette marketing online: a multi-site, multi-product comparison. *JMIR Public Health and Surveill* 2015; 1: e11.
50 Kim I, Begay C, Harrison J, *et al.* E-cigarette-related health beliefs expressed on Twitter within the United States. *AJPM Focus* 2023; 2: 100067.
51 Laestadius L, Wahl M, Vassey J, *et al.* Compliance with FDA warning statement provisions in E-liquid promotion posts on Instagram. *Nicotine Tob Res* 2020; 22: 1823–1830.
52 Christensen J. Juul to pay $438.5 million in settlement with dozens of states over marketing to underage people. Date last accessed: 3 August 2023. Date last updated: 6 September 2022. https://edition.cnn.com/2022/09/06/health/juul-settlement-marketing/index.html
53 Smoking Cessation And Health Conference UK 2023. Speakers/Chairs SCaH 2023. Date last accessed: 6 August 2023. www.smokingcessationandhealth.co.uk/speakers/
54 BBC News. Pregnant women to be handed free vapes by London council. Date last accessed: 6 August 2023. Date last updated: 21 October 2022. www.bbc.co.uk/news/uk-england-london-63331485
55 Whittington J, Simmons P, Phillips A, *et al.* The use of electronic cigarettes in pregnancy: a review of the literature. *Obstet Gynecol Surv* 2018; 73: 544–549.
56 Spindel ER, McEvoy CT. The role of nicotine in the effects of maternal smoking during pregnancy on lung development and childhood respiratory disease. Implications for dangers of E-cigarettes. *Am J Respir Crit Care Med* 2016; 193: 486–494.
57 Cahill K, Gartia M, Sahu S, *et al. In utero* exposure to electronic-cigarette aerosols decreases lung fibrillar collagen content, increases Newtonian resistance and induces sex-specific molecular signatures in neonatal mice. *Toxicol Res* 2021; 38: 205–224.
58 Noël A, Yilmaz S, Farrow T, *et al.* Sex-specific alterations of the lung transcriptome at birth in mouse offspring prenatally exposed to vanilla-flavored E-cigarette aerosols and enhanced susceptibility to asthma. *Int J Environ Res Public Health* 2023; 20: 3710.

59 Chen-Sankey JC, Unger JB, Bansal-Travers M, *et al.* E-cigarette marketing exposure and subsequent experimentation among youth and young adults. *Pediatrics* 2019; 144: e20191119.

Suggested answers

1. d.
2. e.
3. b.
4. d.