

# Toxic and addictive effects of nicotine on children and adolescents: are we sleepwalking into a public health disaster?

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Livingston FC, a mid-table team in the Scottish Premier league, has announced a new sponsorship deal. This may seem of little interest to UK paediatricians, but this is the latest commercial link between sport and the vaping industry. The UK worked hard to reduce the exposure of children to combustible tobacco and its toxic by-products such as nicotine. Since the 1960s, teenage use of cigarettes has steadily decreased via a campaign highlighting negative health impacts, stopping advertising, banning use in social spaces, raising the legal age and limiting access in shops. The alarming rise, from 3% to 43%, in the number of teens using e-cigarettes/vaping (2011–2018) has effectively reversed much of this work to eliminate nicotine exposure and addiction. In the UK, the current approach and legislation for vaping products are based on the assumption that they are safer than combustible tobacco and offer harm reduction to addicts. In this article, we advocate the application of legislation similar to that which applies to other nicotine delivery devices to vaping products due to concerns over their safety profile and potential harm to children prior to birth and beyond.

## EVERYONE KNOWS VAPING IS SAFE, RIGHT?

Nutt *et al* reported that e-cigarettes are '95% safer' than standard cigarettes which is frequently cited in government documents and mainstream media.<sup>1</sup> This dramatic finding was not based on scientific review of published evidence, rather 12 invited people took part in a Delphi process. Two had financial links with the vaping industry (not declared by one), and rather than restricting the process to health concerns from different nicotine systems, the 'harm' compared included smuggling,

deforestation, reduction in arable land and disruption to social cohesion. Their own conclusion stated 'A limitation of this study is the lack of hard evidence for the harms of most products on most of the criteria'. Despite the lack of scientific rigour and possible contamination of their recommendations by commercial interests, the '95% safer' message continues to be referenced in documents endorsed by professional organisations such as a Public Health England report from 2015, and the Royal College of Physicians (RCP) 2016 document 'Nicotine without smoke'.<sup>2</sup> We agree that e-cigarettes do not contain some toxic chemicals that are inhaled with traditional smoking but most products contain nicotine, often at alarmingly high levels. Nicotine is highly addictive and despite a contrary opinion shared by some health professionals, it is not harmless.

## THE HARMFUL EFFECTS OF NICOTINE ON THE FETUS

The deleterious effects of maternal smoking on the developing fetus are well described. It has become clear that adverse consequences of maternal tobacco use are in part due to the toxicity of nicotine.<sup>3</sup> Research on human fetuses exposed to non-combustible tobacco nicotine products such as snuff, animals exposed to nicotine alone and biological research on the cellular effects of nicotine consistently show outcomes ranging from reduced growth, impaired fetal lung and brain development and possible increased sudden infant death syndrome. Maternity services provide anti-smoking resources for mothers to reduce or stop smoking, but a worried mother may be influenced by the '95% safe' message and simply change to e-cigarettes for the duration of her pregnancy, failing to reduce the toxic effects to her unborn child from continued nicotine exposure.

## ACUTE AND LONGER TERM LUNG INJURY

E-cigarette, or vaping, product use-associated lung injury (EVALI) is a

syndrome characterised by an intense inflammatory reaction resulting in respiratory failure. Epidemiological and toxicity studies are clear that e-cigarettes pose significant harm to lung health in the short term. Data from the Centers for Disease Control and Prevention have shown, to date, 2558 hospitalised patients with non-fatal EVALI and 60 patients with a fatal outcome.<sup>4</sup> While it is true that most fatalities were associated with tetrahydrocannabinol-containing liquids, around one-third were products containing nicotine only. Longitudinal data are also accumulating demonstrating longer term health consequences. It took almost 50 years before the medical world realised, or acknowledged, the link between smoking and chronic obstructive pulmonary disease/lung cancer, therefore we must proceed with caution. Studies have already shown that vaping can cause pulmonary inflammation, oxidative stress leading to epithelial damage and necrosis, airway hyper-reactivity and altered host defences.

## ADOLESCENTS AND VAPING BEHAVIOUR

The adolescent brain is a developing organ system and therefore vulnerable to toxins.<sup>5</sup> Exposure to nicotine can have long-term consequences including inhibitory effect on neuronal connectivity (which is rapidly occurring during adolescence) leading to impaired memory and attention. Adolescents are more vulnerable to developing addiction especially to nicotine and withdrawal may increase psychological and psychiatric morbidity in this vulnerable group. Exposure to nicotine can be associated with increased rates of other substance misuse such as cannabis and alcohol.

## HOW MANY CHILDREN VAPE AND WHAT DO THEY VAPE?

Since 2014, e-cigarettes have been the most popular type of nicotine product used by adolescents in the USA.<sup>6</sup> In 2018, 43% of high school students had tried vaping nearly 20% more than had tried traditional cigarettes. Although the majority claim to use e-liquids containing only flavours, 99% of e-liquids sold contain nicotine. Approximately one-third of young e-cigarette users have modified their devices to vape potent cannabis-based oils. It is also clear that emitted vapours are not benign, as many report, since they contain heavy metals and carcinogenic substances, although at a lower level compared with combustible tobacco products.

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## UNINTENDED CONSEQUENCES

The initial concept of e-cigarettes, as a smoking cessation aid for adults with long-time cigarette use, has rapidly evolved into the youth-orientated market with vaping now three times more common in adolescents than among older adults. The idea that these products are currently marketed as medical devices designed to stop nicotine addiction is misplaced. Unlike traditional tobacco products which are banned from advertising, there are increasing sponsorships of sporting teams and stadia by vaping companies. Current design and marketing of vaping products have transformed the use of nicotine by the young. Aggressive social media promotion, the low perception of risk, plus novel and attractive designs help fuel the desire to be part of the 'vaping community'. It seems that all publications on vaping, including the 2016 RCP document, feature a photograph of a young, often smartly dressed, professional person clearly enjoying the product. There is no space for an illustration of an elderly heavy smoker with COPD attempting to reduce their harm from a lifetime of smoking tobacco. The image of life on the 'Planet of the Vapes' is one of tranquillity and coolness, but the reality of unknown toxicity and long-term outcomes is ignored.

## WHAT SHOULD PAEDIATRICIANS DO?

The emerging evidence that vaping is dangerous, that e-cigarettes have increased the number of young nicotine addicts and that young people who use e-cigarettes are more likely to smoke conventional cigarettes should all cause significant alarm. Perhaps most worryingly, dual use is common, even more harmful, and defeats the purpose of these devices as 'cessation aids'.

Currently, the medical community is doing the job of the vaping marketing departments by playing down health risks and promoting their acceptance as the new form of nicotine addiction device. We propose much stricter regulations around the sale and marketing of e-cigarette products together with the development of an effective and clear educational, clinical and public health message which addresses this new epidemic of nicotine addiction in children and young people.

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