

Evidence brief 1: vaping is far less harmful than smoking

It is beyond reasonable doubt that vaping (e-cigarette or ENDS use) and the use of other smoke-free nicotine products are far safer than cigarette smoking. Nearly all the risks from tobacco use arise from smoking: inhaling thousands of chemical agents, many toxic or carcinogenic, produced during the combustion of tobacco leaves in the burning tip of a cigarette.¹ Smoke-free products do not involve combustion, do not produce products or combustion, and lead to greatly reduced exposure to smoking-related toxicants.

Four main categories of smoke-free nicotine products. There are four broad categories of smoke-free consumer nicotine products.



Though each non-combustion product category has a different risk profile, they are clustered closely together on a continuum of risk that has cigarettes at an opposite extreme. Most of the hazardous chemical agents in cigarette smoke are either not present in vape aerosol at detectable levels or present at much lower levels. Similar findings apply to all the smoke-free alternatives.

Chemical basis for reduced risk. Combustion of tobacco creates thousands of chemical reactions and new toxic chemicals not found in the tobacco. Tobacco smoke contains around 7,000 identifiable chemical agents, of which at least 158 are known to be toxic or carcinogenic.² The switch to non-combustible, smoke-free nicotine radically changes the chemical risks and demands a rethink of our whole approach to nicotine. According to independent American experts, these alternative products have *"the potential to disrupt the 120-year dominance of the cigarette"*.³

Major assessments. Several high-quality, independent reviews conclude that exclusive ENDS use poses a small fraction of the risks of cigarettes and likely to be at least 95% lower risk than smoking:

- *Laboratory tests of e-cigarette ingredients, in vitro toxicological tests, and short-term human studies suggest that e-cigarettes are likely to be far less harmful than combustible tobacco cigarettes.* National Academies of Sciences, Engineering, and Medicine, United States (2018).⁴
- *Based on the reviewed evidence, we believe that the 'at least 95% less harmful estimate' (that is, smoking is at least 20 times more harmful to users than vaping) remains broadly accurate at least over short- and medium-term periods, but it might now be more appropriate and unifying to summarise our findings using our other firm statement: that vaping poses only a small fraction of the risks of smoking.* Office for Health Improvement and Disparities, England (2022).⁵

- *Vaping poses only a small fraction of the risks of smoking and switching completely from smoking to vaping conveys substantial health benefits over continued smoking. Based on current knowledge, stating that vaping is at least 95% less harmful than smoking remains a good way to communicate the large difference in relative risk unambiguously so that more smokers are encouraged to make the switch from smoking to vaping. It should be noted that this does not mean e-cigarettes are safe.*

Public Health England (2018).⁶

- *Although it is not possible to quantify the long-term health risks associated with e-cigarettes precisely, the available data suggest that they are unlikely to exceed 5% of those associated with smoked tobacco products, and may well be substantially lower than this figure.*

Royal College of Physicians, London (2016).⁷

This suggestion of at least 95% less risky than smoking has sometimes been misunderstood: it is intended as a clear and actionable way of communicating the scale of risk reduction to consumers and professionals.⁸

Public health advice. The National Health Service of the UK provides straightforward advice to smokers: “Also known as vapes or e-cigs, they’re far less harmful than cigarettes, and can help you quit smoking for good”⁹, and English authorities advertise vaping on TV as a smoking cessation strategy. New Zealand, which has seen an extremely impressive decline in smoking, has similar advice to the public: “Vaping is not harmless, but it is much less harmful than smoking.”¹⁰

Toxicants in the body. The most persuasive evidence comes from biomarker data.¹¹ These are measures of toxicants found in users’ blood, saliva, or urine. Switching from cigarettes to ENDS,^{12 13 14 15 16} heated tobacco,^{17 18 19} snus,^{20 21 22} or nicotine pouches^{23 24} dramatically reduces the exposure to hazardous chemicals associated with smoking. Many biomarkers of exposure fall to background levels or below the limit of detection, and most others are radically reduced.²⁵

Emissions toxicity. Similar findings arise from well-conducted studies of the chemical composition of aerosol emissions, including tests for cytotoxicity, mutagenicity and genotoxicity.²⁶ However, because no humans are involved, these studies are prone to exaggerating risk. The exaggeration of risk arises because the devices can be operated in unrealistic, overheated conditions that would be intolerable for human users. This means the liquid prone to pyrolysis generating excessive levels of thermal decomposition products²⁷ that can be measured by machines.

Health indicators. Other supportive data show improvements in health and welfare for those who switch from smoking to ENDS use completely. Studies show improvements in asthma²⁸ [16], chronic obstructive pulmonary disease (COPD),²⁹ blood pressure,³⁰ lung function,^{31 32} respiratory conditions,^{33 34 35} cardiovascular risk factors,^{36 37} and gum disease.³⁸ One study showed that ENDS typically has a cancer potency of just 0.4% of cigarette smoke.³⁹

Common concerns. Critics of tobacco harm reduction raise a range of concerns, but these are often based on misunderstandings or poor methods.

1. **Correlation and causation.** Many studies find an association between vaping and certain health effects, yet most are deeply flawed.⁴⁰ Almost everyone who uses ENDS and is old enough to suffer serious illness has been smoking for decades. Few studies can isolate the effect of vaping from the impact of a long smoking history; some studies even counted effects associated with vaping that happened before users took up vaping.⁴¹ As noted above, studies which avoid these issues by following within-person changes when switching from smoking to ENDS show substantial reductions in harmful biomarkers and disease symptoms.

2. **“EVALI”**. In 2019-2020, there was an outbreak of severe lung injuries in the United States that was misleadingly named E-cigarette or Vaping Associated Lung Injury.⁴² It was not caused by ENDS, which are *electronic nicotine delivery systems*. It was caused by a thickener, Vitamin E Acetate, added to cannabis (THC) liquids.⁴³ Nicotine vaping was not and could not have been involved in EVALI.⁴⁴ ⁴⁵ There were EVALI victims who claimed not to use THC, but there are strong incentives not to disclose cannabis due to consequences with the law, probation, employment, education, visas and parents.
3. **“No long-term data”**. It is often asserted that we just do not know the long-term effects. While technically true, the point is also misleading. Toxicology has advanced dramatically since the discovery of the health risks of smoking in the 1950s, and we now know a great deal from occupational and environmental health disciplines. We cannot know everything about ENDS risks, but we already know *enough* to be confident that the risks from the use of smoke-free products will be *far less* than those from smoking. Also, the much simpler chemistry will more easily allow remedial action if needed (for example, removing ingredients, changing materials, controlling temperatures). Discouraging or restricting ENDS use while we wait for detailed evidence on long-term outcomes – given that we already know they are much lower risk than smoking – allows the harms of smoking to continue.

We should be mindful of the wise words of the great tobacco epidemiologist Austin Bradford Hill:⁴⁶

All scientific work is incomplete – whether experimental or observational. All scientific work is liable to be upset or modified by advancing knowledge. That does not confer upon us a freedom to ignore the knowledge we already have, or to postpone the action that it appears to demand at a given time.

4. **“Dual-use”**. Some people use both cigarettes and ENDS (“dual use”) and experience lower benefits or no benefits as they continue to smoke. However, many are in a gradual transition to exclusive ENDS use or to dual use with only occasional smoking. Most dual use should be seen as progress from exclusive smoking. Dual use is not the most common form of ENDS use: in the United States, just 29% of adult ENDS users were dual users in 2021.⁴⁷ In Britain, the proportion of vapers also using cigarettes has come down from around two-thirds to around one-third over the last ten years.⁴⁸ It does not appear to reduce quitting intentions.⁴⁹ On the contrary, it may include people who do not want to quit smoking at all but go on to become “accidental quitters”.⁵⁰ ⁵¹ Some argue that dual use makes smokers worse off as if the exposures are additive. This arises from a misrepresentation of cross-sectional studies comparing current smokers and current dual users and, therefore, does not account for differences in dependence and intensity of smoking. Studies that track individuals through smoking to dual-use show benefits.⁵²

Myth-busting. Several excellent resources have been created to tackle myths about product safety and other common concerns about ENDS use. These include:

- a consumer-orientated myth buster by the UK National Health Service⁵³ and myth-busting advice to health professionals from Public Health England⁵⁴
- a detailed myth buster by Action on Smoking and Health (UK) verified by practising scientists⁵⁵
- an analysis of multiple false and misleading claims made in a WHO fact sheet on ENDS⁵⁶
- academic responses to flawed assessments, notably those produced in Australia⁵⁷ ⁵⁸ or the position statements of medical associations⁵⁹
- detailed methodological criticisms of misleading research on specific topics, such as carbonyl formation,⁶⁰ heavy metals migration,⁶¹ or flawed epidemiology.⁶² ⁶³

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