

Comment on:

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Dispositivos Eletrônicos para Fumar
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Executive summary: exploit the benefits of tobacco harm reduction and beware of unintended consequences of prohibition or excessive regulation

Introduction

We write as long-standing experts and advocates for public health and tobacco control. We have provided brief biographies: see [About the authors](#). We confirm we have no conflicts of interest concerning the tobacco, nicotine, or pharmaceutical industries. We are pleased to offer comments on the ANVISA consultation on the prohibition or regulation of *Dispositivos Eletrônicos para Fumar* (DEF).¹ In our comments, we refer to such devices as Electronic Nicotine Delivery Systems (ENDS). However, similar considerations apply to all smoke-free nicotine products – electronic cigarettes, heated tobacco products, smokeless tobacco or snus, and oral nicotine pouches.

The critical issue for public health is whether the product involves combustion and inhalation of smoke, which is the primary cause of disease and premature death. Smoke-free nicotine products have the potential to drive out smoking and completely revolutionise the tobacco market and tobacco industry. We urge the government of Brazil to use regulatory policy to do more to protect the health of Brazil's 22 million smokers by encouraging a mass switch from high-risk cigarettes to low-risk ENDS and accelerating the end of the epidemic of smoking-related disease.

Regulating for public health advantage

We would like to draw attention to our 2017 submission to an ANVISA consultation on ENDS regulation in Brazil. In our response, [Rational Tobacco and Nicotine Policy in Brazil](#), we summarised our perspective on the appropriate public health strategy:²

- *ENDS have two important qualities: (1) they do not involve combustion and so do not create products of combustion, and (2) to an increasing extent, they are capable of replacing smoking for many smokers. Because almost all of the harm associated with tobacco/nicotine use arises from exposure to smoke, not nicotine, then these products are likely, beyond any reasonable doubt, to be much less harmful than smoking (90-100% less harmful depending on product and regulatory standards). The fact that they appeal to smokers as satisfactory alternatives to smoking offers the potential for major changes in the way people use nicotine with great health benefits as a result.*
- *A new regulatory regime could specify age restrictions, product standards, labelling, marketing and use restrictions as appropriate. There is an opportunity for Brazil to gain from experience in the European Union and elsewhere, where there are many valuable lessons to learn.*
- *The effect of the current regulatory regime denies Brazilian smokers access to much lower risk products and has the unintended effect of protecting the cigarette trade and incumbent business interests of the major tobacco companies – even though these companies are trying to switch to marketing lower risk products. There is no justification for this.*
- *We urge ANVISA and the Government of Brazil to embrace tobacco harm reduction in Brazil's approach to tobacco control and create the appropriate regulatory and fiscal framework to allow low-risk products to displace smoking in the consumer market for nicotine. This would meet the demands of people who cannot or do not wish to quit completely, but with much less cancer, cardiovascular and respiratory disease as a result. The current consultation and intention to amend critical regulations provide an opportunity to start that process.*

Since 2017, the scientific and economic evidence to support this position has strengthened, and we wish to provide a brief update and summary in this submission.

Updating our evidence

Any policymaking in this area should recognise three fundamental characteristics of ENDS.

1. While not necessarily without risks, it is clear beyond reasonable doubt that ENDS are much less harmful to health than cigarettes. See [Section 1](#).
2. ENDS contribute to smoking cessation or displace cigarettes among people who would otherwise take up smoking, including young people. See [Section 2](#).
3. ENDS are economic substitutes for cigarettes. Increases in costs or regulatory burdens on ENDS are likely to decrease demand for ENDS but also increase demand for cigarettes. See [Section 3](#).

Evidence for the three characteristics listed above is described briefly in the following three sections of this response and supported by a scientific paper included in [Appendix 1](#). This paper is the work of fifteen past presidents of the scholarly society, the Society for Research on Nicotine and Tobacco. It includes some of the foremost experts in the world.³

The danger of unintended consequences

Because cigarettes are much more harmful than ENDS, it will only take a slight rise in smoking to offset any public health benefit from reduced ENDS use arising from ENDS prohibition or excessive regulation. The critical issue is the interaction of demand for ENDS with demand for much more harmful cigarettes. This is not a new idea: the Royal College of Physicians (London) expressed this clearly in its 2016 report:⁴

... if [a risk-averse, precautionary] approach also makes e-cigarettes less easily accessible, less palatable or acceptable, more expensive, less consumer-friendly or pharmacologically less effective, or inhibits innovation and development of new and improved products, then it causes harm by perpetuating smoking. Getting this balance right is difficult.

The ANVISA approach does not try to “get this balance right” or even recognise that a balance is necessary. Prohibition or excessive regulation of ENDS without considering the effects on smoking could easily lead to a net increase in harm to public health by “perpetuating smoking” or stimulating black market activity.

Policy implications

Finally, we briefly consider policy implications in [Section 4](#), calling for a risk-proportionate approach to regulation and use of ENDS to address the health problems caused by cigarettes. In a risk-proportionate approach, the highest risk products face the most stringent regulation, and low-risk alternatives face fewer and lighter restrictions. Prohibitions are the worst possible policy option: denying law-abiding smokers much safer options; creating black markets; increasing criminality and corruption; and creating new burdens on law enforcement.

ENDS should be used to drive down smoking, the dominant form of tobacco use in Brazil. ENDS should be seen as an opportunity, not a risk.

1 ENDS are much less harmful than cigarettes

The most crucial insight is that *smoking* is the problem. Smoking accounts for 98 per cent of the global burden of tobacco-related mortality.^{5 6} Inhalation of products of combustion – the toxic tar and gases created in the burning tip of a cigarette – is the primary cause of harm, not nicotine itself. As Professor Michael Russell famously explained in 1976:⁷

People smoke for nicotine, but they die from the tar. Their risk of lung cancer and bronchitis might be more quickly and effectively reduced if attention were focused on how to reduce their tar intake, irrespective of nicotine intake.

In this statement, Russell lays the ground for *tobacco harm reduction*: reducing exposure to the toxic tar from cigarette smoke without quitting nicotine as well. This allows smokers an easier path to smoke-free status and means more will be able and willing to take it. Forty-six years later, ENDS make this possible in a format that works for consumers through a compact, efficient device that operates below the temperature at which combustion can occur but delivers a satisfactory nicotine dose through an inhaled aerosol (“vapour”).

There is no real doubt that ENDS are much less risky than cigarettes. Many of the toxicants in tobacco smoke are either not present at detectable levels or present at much lower levels than in cigarette smoke. The most convincing evidence comes from biomarker data (measurement of toxicants in the blood, saliva or urine of users and non-users). In 2018, independent experts for Public Health England reviewed the biomarker data and concluded:⁸

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.

The United States National Academies of Science, Engineering and Medicine concluded:⁹

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.

A more detailed discussion of the health impacts of e-cigarettes compared to cigarettes forms part of a recent paper by fifteen past presidents of the independent Society of Research on Nicotine and Tobacco (SRNT).¹⁰ These authors, some of the world’s leading authorities, summarise the safety case as follows:

Many scientists have concluded that vaping is likely substantially less dangerous than smoking because of the following:

- *The number of chemicals in cigarette smoke, greater than 7000, exceeds that of e-cigarette aerosol by 2 orders of magnitude.*

- *Among potentially toxic substances common to both products, cigarette smoke generally contains substantially larger quantities than e-cigarette aerosol. However, e-cigarette aerosol contains some substances not found in cigarette smoke.*
- *Biomarkers reflecting exposure to toxic substances are present at much higher levels in exclusive cigarette smokers than in exclusive vapers, and studies of smokers who switch to e-cigarettes find decreases in toxicant exposures.*
- *Tests of lung and vascular function indicate improvement in cigarette smokers who switch to e-cigarettes. Exclusive users of e-cigarettes (most being former smokers) report fewer respiratory symptoms than do cigarette smokers and dual users.*

The SRNT past presidents’ paper was published in the American Journal of Public Health and is appended as [Appendix 1](#). Citations for the statements above can be accessed via the paper.

2 ENDS help smokers quit and displace smoking

2.1 Adult smoking cessation

There is considerable converging evidence from multiple sources, including randomised controlled trials, observational studies, population trends, and market data, that people use ENDS to quit smoking, cut down, transition to smoke-free status over time, or as a diversion from smoking in the first place.

The evidence for ENDS as a substitute for cigarettes and a driver of smoking cessation comes from multiple sources, each with its strengths and weaknesses, but taken together make a strong case – and *more* robust than the conventional smoking cessation treatments. The British smoking cessation expert, Professor Robert West, summarised the state of evidence in a 2019 presentation.¹¹ The slide from Professor West’s presentation above summarises his view of the evidence, and a link to the whole presentation is provided in the endnote.

The slide is titled "Effectiveness for smoking cessation" and features a small portrait of Professor Robert West in the top right corner. It lists three points: 1. Consistent evidence from RCTs that e-cigarettes can be at least as effective as licensed nicotine products when used in a quit attempt; 2. Complementary evidence from comparative observational studies of e-cigarettes when used under real-world conditions, though may be context- and population-dependent; 3. Supportive evidence from population trends in England and the US showing a positive association between prevalence of e-cigarette use in the population and smoking cessation rates. To the right of each point is a QR code with a "SCAN ME" button below it.

The following provides an overview of studies that support the evidence framework articulated in Professor West’s presentation.

- *Randomised controlled trials.* Several recent trials show positive results.^{12 13} The most substantial clinical trial to date showed e-cigarettes with approximately twice the smoking cessation efficacy of NRT¹⁴. There is an accumulating evidence base: the Cochrane Review, which provides a world-renowned synthesis of clinical trial evidence, concluded in September 2021.¹⁵

Nicotine e-cigarettes probably do help people to stop smoking for at least six months. They probably work better than nicotine replacement therapy and nicotine-free e-cigarettes. They may work better than no support, or behavioural support alone, and they may not be associated with serious unwanted effects

The Cochrane Review restricts its evidence reviews to clinical trial evidence. But a range of evidence from other sources strengthens the support for ENDS for smoking cessation.

- *Observational data.* There is evidence that smokers who use e-cigarettes are more likely to quit smoking than those who do not.^{16 17}
- *Population trends.* There is evidence that smoking cessation activity also increases as the prevalence of e-cigarette use increases in a population.^{18 19 20 21}
- *Modelling studies.* Modelling studies based on the experience show substantial public health potential even when parameterised with sceptical assumptions.^{22 23}
- *Testimonials.* Thousands of users provide compelling reports of quitting smoking with ENDS.²⁴

2.2 Dual use is part of a positive transition

Some claim that the “dual use” of ENDS and cigarettes is problematic. However, it is better understood as a part of a transition pathway from exclusive smoking to exclusive ENDS use – not everyone switches immediately.^{25 26 27} In Britain, the proportion of ENDS users who are dual users has fallen steadily from two-thirds in 2014 to less than one-third in 2021, suggesting a steady migration from dual use to exclusive use of ENDS.²⁸ The evidence also suggests that vaping encourages smoking cessation in smokers who were not otherwise interested in quitting smoking. These smokers become what is known as “accidental quitters”.²⁹

2.3 Diversion of young people from smoking

Again, the evidence points to interactions between ENDS use and cigarettes among adolescents, with ENDS functioning *as a diversion* from smoking for adolescents.^{30 31 32} This is consistent with observed US adolescent population trends, which have seen a sharp decline in smoking as ENDS use has risen.^{33 34} US and UK data show that the most intensive adolescent use of ENDS is among those most likely to smoke.^{35 36 37} There is little evidence of dependence in ENDS users who are never-smokers, and these users generally use ENDS infrequently.³⁸ The US high school past-30-day vaping rate fell from 27.5% in 2019³⁹ to just 11.3% in 2021.⁴⁰ This rapid change suggests there is a core of more intense users who would otherwise be smoking (and who likely benefit from vaping) and a broader group of experimental or frivolous ‘party’ users that justify less public health concern.

2.4 Looking at all the evidence

Taken as a whole, the evidence makes a compelling case that smoke-free alternatives to cigarettes displace smoking. The Tobacco Treatment Network of the SRNT recently argued:⁴¹

Strategies used for combustible product cessation may be adapted for novel products, and treatment recommendations for tobacco use disorder should be made within the context of a harm reduction framework wherein alternative product use may be the desired outcome.

A further discussion of the smoking cessation evidence is summarised in the letter from fifteen past presidents of SRNT,¹⁰ which is also appended at [Appendix 1](#). The authors conclude:

Although not the final word, the totality of the evidence indicates that frequent vaping increases adult smoking cessation. Smokers unable to quit smoking with evidence-based cessation methods should be well informed about the relative risks of vaping and smoking and vaping's potential to help them quit smoking.

3 ENDS function as substitutes for cigarettes

It is not uncommon for two goods to function as economic substitutes if they represent different forms of similar consumption in competition: tea and coffee, beef and lamb, or rice and pasta. This means that the price of one product will affect the demand for the other through a positive 'cross-elasticity'. It also means that regulation that suppresses demand for one product will increase demand for the substitute product.

Evidence is emerging that ENDS use displaces smoking and promotes smoking cessation (see section 2 above). Further evidence for substitution comes from analyses of the effects of measures to control ENDS use. Evidence suggests e-liquid flavour bans,⁴² e-cigarette advertising bans,⁴³ and access restrictions⁴⁴ may *increase* cigarette smoking.

However, the most direct and relevant evidence comes from studies of the demand response to ENDS taxes that have been imposed. The World Health Organisation argues that:⁴⁵

ENDS/ENNDS and cigarettes are substitutes – higher cigarette prices are associated with increased ENDS/ENNDS sales.

A significant body of literature broadly supports WHO's assertion.^{46 47 48 49 50 51 52 53 54 55 56}

Substitution effects make a significant difference to the overall public health consequences of regulation. The fact that ENDS and cigarettes are economic substitutes should be a central consideration in ENDS regulatory policy because this is the mechanism by which prohibition or excessive regulation of ENDS is likely to do more harm than good.

4 Consequences for policy

4.1 The policy of prohibition and the risks of unintended harmful consequences

In our experience, governments should reject prohibitions or anticipate numerous perverse consequences. The arguments against ENDS prohibition are well established.⁵⁷ They are based on the experience of prohibition of illicit drugs,⁵⁸ alcohol,⁵⁹ and tobacco.^{60 61 62} It is almost impossible to suppress demand for a recreational stimulant like nicotine. Many people will wish to use nicotine products that do not have the severe health impacts of cigarettes and other combustibles.

A prohibition does not make the banned products disappear. A prohibition changes how the products are supplied, who supplies them, and at what price. Over time, this demand for ENDS products would be met through cross-border trade, internet sales, and ultimately more established criminal networks with aggravated risks of bribery and corruption. It is also likely that young people would play a significant role in the illicit supply chain.

A further consideration is the behavioural responses to a prohibition of ENDS. This could take the form of illicit manufacture and sale of ENDS in Brazil, cross-border trade by which foreign producers undermine law-abiding Brazilian producers, an increase in DIY home mixing or formation of informal

supply chains, and various possible workarounds. Many of the likely behavioural responses create significant additional risks compared to a well-regulated lawful market.

A better strategy would be to allow legally available ENDS products to compete with cigarettes rather than to create a regulatory protection for the cigarette trade.

4.2 Adopt risk proportionate regulation

The most effective approach will be to abandon prohibition in favour of “risk-proportionate” regulation. This is not a novel idea but reflects the standard regulatory practice of imposing burdens and restrictions that reflect the voluntary and involuntary risks to those most directly affected.

In a risk-proportionate approach, the main regulatory levers are applied differentially. The most stringent and restrictive regulation would be applied to the most harmful products, cigarettes. Regulation of the smoke-free alternatives would focus on consumer protection (i.e. benefits to the consumer) and control of uptake by adolescents where this does not cause significant harm to adult smokers. The table below illustrates the concept.

Measure	Smoking products	Smokefree products
Taxation	Relatively high taxes	Low or zero tax (VAT or sales tax only)
Illicit trade	Track and trace (FCTC protocol)	Complaint-driven
Advertising	Prohibit other than within trade	Control themes and placement
Warnings	Graphic warnings depicting disease	Messages encouraging switching
Public places	Legally mandated controls	Up to the discretion of the owner
Plain packaging	Yes	No
Ingredients	Control reward-enhancing additives	Blacklist material health hazards
Flavours	Prohibit	Allow but restrict ingredients that could be hazardous for inhalation
Flavour descriptors	Not applicable if flavours banned	Control appeal to youth/trademarks
Age restrictions	No sales to under-21s	No sales to under-18s
Internet sales	Banned	Permitted with age controls
Product standards	Control risks and reduce the appeal	Control risks

5 Conclusion

The primary goal of Brazil’s tobacco policy should be to reduce excess mortality and morbidity. In practice, this means reducing *smoking* as deeply and rapidly as possible. Tobacco harm reduction provides a fast-acting, market-based strategy for reducing smoking and eliminating most smoking-related risks. The regulation of ENDS and other smoke-free products should always be considered as part of a regulatory system that covers all the nicotine products, both smoked and smoke-free. The aim should be to encourage the migration from high-risk to low-risk products and support positive behaviour change. Regulators should take great care to avoid the perverse consequences of prohibitions and use regulation instead. Risk-proportionate regulation provides a robust basis for controlling the consumer nicotine market and creates strong incentives that support public health.

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Appendix 1

Communication to the American Journal of Public Health by fifteen past presidents of the Society for Research on Nicotine and Tobacco (SRNT) August 2021

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Balancing Consideration of the Risks and Benefits of E-Cigarettes

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The topic of e-cigarettes is controversial. Opponents focus on e-cigarettes' risks for young people, while supporters emphasize the potential for e-cigarettes to assist smokers in quitting smoking. Most US health organizations, media coverage, and policymakers have focused primarily on risks to youths. Because of their messaging, much of the public—including most smokers—now consider e-cigarette use as dangerous as or more dangerous than smoking. By contrast, the National Academies of Science, Engineering, and Medicine concluded that e-cigarette use is likely far less hazardous than smoking. Policies intended to reduce adolescent vaping may also reduce adult smokers' use of e-cigarettes in quit attempts.

Because evidence indicates that e-cigarette use can increase the odds of quitting smoking, many scientists, including this essay's authors, encourage the health community, media, and policymakers to more carefully weigh vaping's potential to reduce adult smoking-attributable mortality.

We review the health risks of e-cigarette use, the likelihood that vaping increases smoking cessation, concerns about youth vaping, and the need to balance valid concerns about risks to youths with the potential benefits of increasing adult smoking cessation. (*Am J Public Health*. Published online ahead of print August 19, 2021:e1–e12. <https://doi.org/10.2105/AJPH.2021.306416>)

The use of nicotine-containing electronic- or e-cigarettes has divided the tobacco control community along a spectrum from fervent opponents to enthusiastic supporters. Opponents emphasize that vaping can cause nicotine addiction among young people and could lead some to become dependent cigarette smokers, possibly “renormalizing” smoking. They cite research indicating that nicotine may harm adolescents' developing brains. Some consider vaping's health risks substantial, and some question whether vaping decreases smoking cessation.¹ By contrast, proponents present evidence that vaping assists smokers in quitting smoking and believe that vaping poses far less risk to users' health than does smoking. Smoking among youths,

they observe, has declined rapidly during vaping's ascendancy.²

Many US governmental health agencies^{3–6} and nongovernmental medical^{7,8} and health organizations^{9–12} focus primarily on vaping's risks for young people. These organizations' pronouncements and their influence on policymakers and the media have had a profound impact on the public's understanding of vaping. A study of US news articles on e-cigarettes found that, from 2015 to 2018, 70% of articles mentioned vaping's risks for youths, while only 37.3% noted potential benefits for adult smokers.¹³ Of respondents to a 2019 national survey, nearly half considered vaping nicotine just as harmful as or more harmful than cigarette smoking. Only 1 in 8 considered vaping less harmful. (The rest

responded “I don't know.”¹⁴) By contrast, the US National Academies of Sciences, Engineering, and Medicine¹⁵ and the British Royal College of Physicians¹⁶ have concluded that vaping is likely far less hazardous than smoking cigarettes.

The public's inaccurate perception worsened following a 2019 vaping-associated acute pulmonary disease outbreak (named “e-cigarette or vaping use-associated lung injury” [EVALI]) that caused 68 fatalities.¹⁷ Media coverage was extensive. Several states and cities promptly banned retail and online sale of flavored e-cigarettes.¹⁸ In early 2020, however, research attributed the illness to vitamin E acetate, an adulterant in illicit tetrahydrocannabinol (THC) vaping devices shown to produce pulmonary injury in animals.^{19–21} A small percentage

of patients with EVALI reported vaping only nicotine, but they were primarily in states where THC was illegal, and most had no toxicology testing.²² Once the potential harm of vitamin E acetate was publicized and adulterated THC removed from the market, the incidence of new cases fell precipitously.¹⁹ Yet, after the outbreak, two thirds of respondents to a poll related the lung disease deaths to use of “e-cigarettes such as JUUL.” Only 28% related the deaths to use of “marijuana or THC e-cigarettes.”²³

Scientists differ in their views of the relative risks and benefits of vaping nicotine, and of their implications.^{1,2,24,25} Many, including this article’s authors, believe that vaping can benefit public health, given substantial evidence supporting the potential of vaping to reduce smoking’s toll. Our objective is to encourage more balanced consideration of vaping within public health and in the media and policy circles.

In the following pages we address:

- the health risks of vaping,
- the likelihood that vaping increases smoking cessation,
- the principal concerns about youth vaping, and
- balancing concerns about risks to youths with potential benefits for adult smokers.

THE HEALTH RISKS OF VAPING

According to the National Academies of Sciences, Engineering, and Medicine, “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.”^{15(p1)} The British Royal College of

Physicians similarly concluded that “vaping isn’t completely risk-free but is far less harmful than smoking tobacco.”¹⁶

High-quality clinical and epidemiological data on vaping’s health effects are relatively sparse. There are no data on long-term health effects, reflecting the relative novelty of vaping and the rapid evolution of vaping products. Determining even short-term health effects in adults is difficult because most adult vapers are former or current smokers.

Some studies find that vaping may worsen asthma, bronchitis, and cough, including among nonsmoking young people.^{26,27} By contrast, a few studies found that smokers with asthma or chronic obstructive lung disease see symptoms improve after switching to e-cigarettes.^{28,29} Randomized switching trials (cigarettes to e-cigarettes) document improvements in respiratory symptoms.^{30,31}

Laboratory studies have reported potentially adverse effects of e-cigarette aerosol in cells and animals.^{26,32} It is difficult, however, to extrapolate from exposure conditions in cells and animals to humans.²⁶ Human experimental studies have focused on acute effects,³³ which may not predict future disease. For example, e-cigarettes acutely impair tests of endothelial function, a common feature of cardiovascular disease, but when smokers switch from cigarettes to e-cigarettes, endothelial function normalizes.^{34,35} A recent study detected no difference in biomarkers of inflammatory and oxidative stress in exclusive e-cigarette users and nonusers of either cigarettes or e-cigarettes.³⁶

There is little evidence that e-cigarettes pose significant cancer risk.¹⁵ However, some studies raise

concerns that warrant long-term follow-up of vapers.^{37,38}

Many scientists have concluded that vaping is likely substantially less dangerous than smoking because of the following^{15,16}:

- The number of chemicals in cigarette smoke, greater than 7000,³⁹ exceeds that of e-cigarette aerosol by 2 orders of magnitude.^{40,41}
- Among potentially toxic substances common to both products, cigarette smoke generally contains substantially larger quantities than e-cigarette aerosol.^{42–44} However, e-cigarette aerosol contains some substances not found in cigarette smoke.⁴⁵
- Biomarkers reflecting exposure to toxic substances are present at much higher levels in exclusive cigarette smokers than in exclusive vapers, and studies of smokers who switch to e-cigarettes find decreases in toxicant exposures.^{31,46–50}
- Tests of lung and vascular function indicate improvement in cigarette smokers who switch to e-cigarettes.^{28,29,34} Exclusive users of e-cigarettes (most being former smokers) report fewer respiratory symptoms than do cigarette smokers and dual users.⁵¹

However, questions remain.⁵² Ongoing research will lend further insight into the products’ absolute and relative dangers.

THE LIKELIHOOD THAT VAPING INCREASES SMOKING CESSATION

A growing body of evidence indicates that vaping can foster smoking cessation, although the evidence is not definitive.^{53,54}

Randomized Trials

In an English smoking cessation randomized controlled trial,⁵⁵ smokers assigned to e-cigarettes achieved nearly twice the rate of biochemically confirmed smoking cessation at 1 year (18%) than smokers assigned to nicotine replacement therapy (9.9%); all received identical behavioral counseling. While 80% of those who quit with e-cigarettes were still vaping, they were no longer exposed to smoking's substantially higher risk.

A New Zealand trial found that at 6 months, nicotine patch with nicotine e-cigarettes outperformed patch with nicotine-free e-cigarettes and patch alone. Thus, in addition to aiding quitting when used alone, nicotine e-cigarettes may increase the effectiveness of existing cessation aids.⁵⁶

Examining 26 randomized controlled trials, a recent Cochrane Review concluded that "There is moderate-certainty evidence that ECs [electronic cigarettes] with nicotine increase quit rates compared to ECs without nicotine and compared to nicotine replacement therapy."⁵³ Another meta-analysis drew similar conclusions, albeit with less certainty.⁵⁷ However, the US Preventive Services Task Force's smoking cessation practice guideline did not find the evidence convincing.⁵⁸ As such, and for reasons the Cochrane Review describes, more well-designed clinical trials are needed.

Noteworthy is the lack of trials by e-cigarette manufacturers in pursuit of regulatory agency approval to use e-cigarettes for smoking cessation, likely reflecting the profitability of selling e-cigarettes as consumer products, rather than medicinal devices.

Population Studies

Collectively, population studies' findings are consistent with a near doubling of quit attempt success, found in the randomized controlled trials, and the fact that e-cigarettes are smokers' most used aid in quit attempts.⁵⁹ Four studies⁶⁰⁻⁶³ found significant increases in smoking cessation (10%–15%) that the authors associated with vaping. A Centers for Disease Control and Prevention study reported that, in 2018, 15.1% of smokers had quit smoking for 6 months or longer using e-cigarettes, compared with 3.3% using other noncigarette tobacco products and 6.6% using no tobacco products.⁶⁴ Another study identified a near doubling of self-reported cessation among users of e-cigarettes or varenicline compared with smokers not using these products.⁶⁵ Consistent with these population studies, simulation analyses have generally found that vaping increases smoking cessation, avoiding large numbers of premature deaths.⁶⁶⁻⁶⁹

Other researchers have found regular and frequent e-cigarette use to be associated with increased smoking cessation, while infrequent use was not.⁷⁰⁻⁷⁵ This could reflect self-selection, with frequent vapers possibly liking vaping more and being more motivated to quit smoking. Infrequent vapers might use vaping as a temporary nicotine source where smoking is prohibited.^{73,76}

Other researchers have reported reduced cessation rates among smokers who vape.^{77,78} However, many failed to distinguish frequency of vaping, introducing the risk of the selection biases just noted. Other studies included only current vapers who also smoke, systematically excluding vapers who had successfully quit smoking.^{53,78}

An often-cited meta-analysis found vapers' odds of quitting smoking 28% lower than for nonvaping smokers.⁷⁷ This analysis combined clinical trials, cohort studies, and cross-sectional analyses, an inappropriate practice for meta-analyses.⁷⁹ Furthermore, the individual studies' sources of bias could be compounded in a meta-analysis, possibly producing an incorrect result.⁷⁶

Cigarette Sales

For years, US cigarette sales declined 2% to 3% annually. More recently, as vaping product sales increased, cigarette sales decreased much more rapidly. Conversely, following the EVALI outbreak and e-cigarette sales restrictions, sales of e-cigarettes fell and sales of cigarettes resumed their prevaping pattern.⁸⁰ Studies finding a positive cross-price elasticity of demand between cigarettes and e-cigarettes support the conclusion that the products are substitutes.^{81,82}

Support for the plausibility of an inverse causal relationship between vaping and smoking comes from countries in which startling decreases in cigarette sales have accompanied rising sales of another novel nicotine product, heated tobacco products (HTPs). Like e-cigarettes, HTPs expose users to lower levels of toxicants than do cigarettes.⁸³ In Japan, HTP adoption from 2015 to 2019 was accompanied by cigarette sales declining by a third.⁸⁴ In both cases—HTPs in Japan and e-cigarettes in the United States—as sales of reduced-risk products rose, cigarette sales fell.

Unintended Consequences of Policies Restricting Vaping

Studies have found that policies intended to restrict e-cigarette use may

have unintentionally increased cigarette smoking. One study associated a Minnesota e-cigarette tax with increased adult smoking and reduced cessation, estimating that taxing e-cigarettes at the same rate as cigarettes nationwide could deter 2.75 million smokers from quitting smoking over a decade.⁸⁵ Two other studies found state restrictions on minors' access to e-cigarettes associated with higher adolescent cigarette smoking.^{86,87}

Implications

Although not the final word, the totality of the evidence indicates that frequent vaping increases adult smoking cessation. Smokers unable to quit smoking with evidence-based cessation methods⁸⁸ should be well informed about the relative risks of vaping and smoking and vaping's potential to help them quit smoking. They should understand that, while the long-term health consequences are unknown, completely substituting vaping for smoking likely reduces health risks, possibly substantially.¹⁵ Dual use of cigarettes and e-cigarettes will not have a comparable beneficial effect.⁸⁸ However, a period of dual use may be necessary for some smokers to transition from smoking. Because vaping itself poses some risk, the best advice is to eventually stop vaping as well.

THE PRINCIPAL CONCERNS ABOUT YOUTH VAPING

The principal objections to vaping regard 3 potential effects on youths:

- Vaping can cause nicotine addiction among young people who never would have tried smoking.

- Vaping by never-smoking youths may cause some to try smoking, risking “renormalizing” smoking among young people.
- Nicotine can harm developing brains, and vaping nicotine may have other adverse health effects.

Vaping as a Cause of Nicotine Addiction

Vaping likely addicts some young people to nicotine. However, the evidence does not suggest it is addicting very large numbers.⁸⁹ Jarvis et al. concluded that “Data . . . do not provide support for claims of a new epidemic of nicotine addiction stemming from use of e-cigarettes.”⁹⁰ Jackson et al. recently reported that the e-cigarette–driven increase in nicotine product use among high-school students is not associated with an increase in population-level dependence.⁸⁹ Among tobacco-naïve youths, in addition to low vaping prevalence (9.1% in the past 30 days in 2020) and frequency (2.3% vaping \geq 20 days in the past 30 days),⁹¹ small percentages exhibited signs of nicotine dependence.⁹⁰

Frequent use is much more common among current or former smoking youths than among never-smokers.⁹⁰ Many former smokers were already addicted to nicotine before initiating vaping. With high-school students' smoking declining at an increasing rate since youths began using e-cigarettes,^{92,93} some may vape to reduce or quit smoking.

Nonetheless, to the extent that vaping creates nicotine addiction among otherwise tobacco-naïve youths, concerted efforts are needed to reduce youth vaping. The new minimum age of 21 years for purchasing tobacco products

should help.⁹⁴ Governmental agencies^{3,95} and voluntary organizations^{12,96} disseminate vaping's risks to youths through Web sites, social media, and television campaigns. Voluntary organizations lobby Congress and state governments to adopt policies restricting youth access to e-cigarettes.

Recent policy attention has focused on restricting the availability of e-cigarettes with flavors,⁹⁷ a principal attraction for youths.⁹⁸⁻¹⁰¹ While flavor bans could reduce youth interest in e-cigarettes, they could also reduce adult smokers' vaping to quit smoking.¹⁰²⁻¹⁰⁴ Like youths, adults prefer nontobacco flavors,¹⁰⁵ both groups favoring fruit and sweet flavors.^{106,107}

Policies regarding flavors reflect the more general issue considered in this article: the need to create a balance between the sometimes-conflicting goals of preventing youth vaping and supporting adults' smoking cessation attempts, particularly for smokers unable or unwilling to quit otherwise.¹⁰⁸

Vaping Causing Smoking Initiation

Prospective studies have found that young people who had vaped but never smoked cigarettes were more likely to have tried cigarettes several months to 2 years later than contemporaries who had neither smoked nor vaped.^{15,109-113} Some commentators thus consider vaping a “gateway” into smoking.^{114,115}

Other observers believe the relationship reflects a “common liability”¹¹⁶: young people who vape are generally more prone to risky behavior¹¹⁷; hence, they might be more likely to try smoking even without vaping.¹¹⁸⁻¹²¹ Three recent studies have concluded that vaping likely diverts more young people from smoking than encourages them to

smoke.¹²²⁻¹²⁴ Conversely, some prospective studies have found the vaping–smoking relationship strongest in youths at low risk of smoking.¹²⁵⁻¹²⁷

Obvious plausible correlates are often not considered, however.¹²⁸ Importantly, few studies include youths' use of other psychoactive substances, including marijuana and alcohol. In 1 study, inclusion of marijuana and 3 other variables eliminated the otherwise statistically significant link between vaping and subsequent smoking.^{126,127} Most studies do not even consider previous use of tobacco products other than cigarettes. Adjustment for confounders substantially reduces the relationship between vaping and subsequently trying cigarettes.¹²⁹

Numbers of cigarettes smoked at follow-up are frequently very low, only 1 or 2 in the past 12 months in one study.¹³⁰ Furthermore, the prospective studies generally have not examined progression to regular dependent smoking, with 1 recent exception.¹³¹ Only a small proportion of youths who experiment with smoking become regular smokers. Kim and Selya found that while e-cigarette use was associated with ever trying smoking, it was not associated with current continued smoking.¹¹⁹ Pierce et al. recently concluded the opposite.¹³¹ Shahab et al. reported that less than 1% of US students who initiated nicotine or tobacco use with e-cigarettes were established cigarette smokers.¹³²

If vaping causes some young people to try cigarettes, the aggregate impact must be small. A recent study⁶⁸ estimated that if vaping increases non-smoking youths' odds of trying cigarettes by 3.5 (as reported by Soneji et al.¹⁰⁹), smoking initiation among young adults would increase less than 1 percentage point. Furthermore, US survey data

demonstrate that smoking among young people has declined at its fastest rate ever during vaping's ascendancy.^{92,93,133} If vaping increases smoking initiation, other unknown factors more than compensate.

Nicotine Harming Developing Brains

Animal model studies have found that nicotine can affect maturation of brain parts associated with executive function and decision-making, potentially leading to more impulsive behavior, cognitive deficits, and greater likelihood to self-administer other drugs.^{134,135} In addition, there is evidence in humans of neurological changes attributed to nicotine in the brains of adolescent smokers, interpreted by some as reflecting similar harmful effects to those in the animal models.^{136,137}

These studies lead some researchers to suspect that adolescent nicotine use in any form may lead to long-term structural and functional brain changes with associated negative implications for cognition or impulse control.¹³⁸ However, given species differences and questions about the relevance of experimental animal nicotine dosing paradigms to human use patterns, the validity of extrapolation to humans is speculative. Whether impaired brain development with behavioral consequences occurs in young nicotine consumers is difficult to determine because of potential confounding of genetic and socioeconomic factors, the influence of other substance abuse, and the role of preexisting neuropsychiatric problems associated with youth smoking. Research has yet to isolate nicotine use in the adolescent years and then examine later sequelae. Still, concerns about brain function effects of nicotine

exposure through vaping deserve serious examination.⁹⁸

Concerns About Youth Vaping in Context

Several considerations raise the question of whether, for youth as a whole, vaping creates dangerous levels of nicotine exposure that would not have occurred in the absence of vaping.

- The large majority of nontobacco product-using young people do not vape and, thus, have no nicotine exposure.⁹⁰
- Among those who vape, most do so infrequently; many are short-term experimenters.⁹⁰
- Frequent vaping is most common among current or former smokers, individuals already exposed to nicotine.⁹¹
- The most dangerous form of youth exposure to nicotine, cigarette smoking, has declined at an unprecedented rate during the era of youth vaping.^{92,93,133} Use of other tobacco products has declined as well.¹³⁹

Still, concerns emanating from substantial increases in youth vaping in 2018 and 2019 are readily understandable and important to address. A sizable decline in 2020 is encouraging.¹³⁹ We must continue monitoring youth vaping, learning more about potential harms and identifying effective prevention strategies. However, as public health groups, the media, policymakers, and the general public focus on youth vaping, vaping's potential to help adults quit smoking too often gets lost. That may come at a significant public health cost. Fourteen percent of US adults smoke; smoking annually causes nearly half a

million deaths. Anything that can reduce that toll deserves serious attention.

With the focus on youths creating an environment in which smokers believe that vaping is as dangerous as or more dangerous than smoking,¹⁴ many smokers struggling to quit may be unwilling to try vaping as an alternative. This likely translates into less smoking cessation than if smokers correctly understood the relative risks of vaping and smoking.

BALANCING CONCERNS ABOUT RISKS AND POTENTIAL BENEFITS

Research comparing vaping's risks for youths with potential benefits for adult smokers has found the latter to dominate,⁶⁶ potentially avoiding the smoking-produced loss of tens of millions of life-years.^{67,68} Vaping cannot end cigarette smoking. But vaping can complement tried-and-true methods of reducing smoking, including taxes on combustible tobacco products, smoke-free workplace laws, marketing restrictions, plain packaging with graphic warning labels, antismoking media campaigns, tobacco-21 laws,⁹⁴ and evidence-based smoking cessation treatment.⁸⁸

We believe the potential lifesaving benefits of e-cigarettes for adult smokers deserve attention equal to the risks to youths.¹⁴⁰ Millions of middle-aged and older smokers are at high risk of near-future disease and death. Quitting reduces risk.⁸⁸ Young people will not experience smoking-related (and conceivably vaping-related) chronic diseases for 3 decades, and likely not at all if they quit within a decade or 2. Social pressures to quit smoking will probably remain strong, and quitting aids may improve. Furthermore, as noted

previously, the rate of smoking among young people has declined while vaping has increased.^{92,93,133} Vaping may addict some youths to nicotine, but many fewer than popularly believed.^{89,90}

Seeking a Sensible Mix of Policies

To date, the singular focus of US policies on decreasing youth vaping may well have reduced vaping's potential contribution to reducing adult smoking. Those policies include taxing e-cigarettes at rates comparable to cigarette taxes,¹⁴¹ decreasing adult access to flavored e-cigarettes that may facilitate smoking cessation,¹⁰³ and convincing the public—including smokers—that vaping is as dangerous as smoking.¹⁴

The public health objective should be to develop policies and interventions that both reduce youth vaping and increase adult smoking cessation.^{97,120,140,142} While an in-depth discussion of an optimal policy mix exceeds the scope of this article, we here present illustrative policies that would serve this objective. These are all in addition to conventional evidence-based prevention and cessation measures.

- Tax cigarettes and other combustible tobacco products heavily; impose a more modest tax on e-cigarettes. Taxes should be proportionate to risk. A much higher tax on combustibles will encourage adult smokers to quit smoking or to switch to less expensive e-cigarettes. By raising the price of e-cigarettes, a modest tax will discourage their use by price-sensitive youths.¹⁴¹

- Because both youth and adult smokers find e-cigarette flavors attractive,⁹⁸⁻¹⁰⁷ banning all (or most) flavors risks reducing smokers' use of e-cigarettes to quit smoking¹⁰²⁻¹⁰⁴ at the same time that it reduces youth vaping.^{99,101} An alternative would be to limit the retail sale of flavored e-cigarettes to adult-only outlets such as vape shops. An imperfect policy for either goal, this approach could benefit both.
- Government agencies and health organizations should develop nuanced, targeted communications that emphasize the realistic concerns about youth vaping and, separately, the potential benefits of e-cigarettes as less-risky (but not risk-free) alternatives for adult smokers otherwise unable or unwilling to quit smoking.
- The US Food and Drug Administration (FDA) should strictly regulate e-cigarette advertising and marketing, prohibiting all marketing directed at, or attractive to, youths and young adults, including all "lifestyle" advertising. They should limit advertising to a "switch" theme directed clearly, and exclusively, to adult smokers otherwise unable to quit smoking.
- FDA should implement its thoughtful comprehensive 2017 plan,¹⁴³ mandating reduction of nicotine in cigarettes to levels incapable of sustaining addiction, while ensuring the availability of consumer-acceptable reduced-risk nicotine products. To achieve the latter, the agency should develop product standards for products like e-cigarettes, ensuring minimization of risk associated with the product class while maintaining consumer acceptability.

The Role of Nicotine in Tobacco-Produced Disease

FDA predicated its comprehensive plan on recognition of the continuum of risk in nicotine products.¹⁴³ Nicotine is the chemical in tobacco that fosters addiction. However, toxic constituents other than nicotine, predominantly in smoked tobacco, produce the disease resulting from chronic tobacco use.^{143,144} Nicotine-yielding products vary in risk from FDA-approved nicotine replacement therapy products at the lowest end of the risk continuum to combustible cigarettes at the highest.

Unfortunately, the public has a distorted view of the dangers associated with nicotine per se. In a recent survey, 57% of respondents incorrectly agreed that “nicotine in cigarettes is the substance that causes most of the cancer caused by smoking.” Only 18.9% disagreed. (The rest answered “Don’t know.”)¹⁴ In a recent survey of physicians, 80% strongly, but incorrectly, agreed that nicotine causes cancer, cardiovascular disease, and chronic obstructive pulmonary disease.¹⁴⁵

CONCLUSIONS

We share the very legitimate concerns about youth vaping with the entire field of public health. Our goal is to put those concerns in perspective. We agree with former Surgeon General C. Everett Koop who, in 1998, urged that “[A]s we take every action to save our children from the ravages of tobacco, we should demonstrate that our commitment to those who are already addicted . . . will never expire.”¹⁴⁶ The latter appears at risk today.

While evidence suggests that vaping is currently increasing smoking cessation, the impact could be much larger if the public health community paid serious attention to vaping’s potential to help adult smokers, smokers received accurate information about the relative risks of vaping and smoking, and policies were designed with the potential effects on smokers in mind. That is not happening.

The need to pay attention to adult smokers is particularly important from a social justice perspective. African Americans suffer disproportionately from smoking-related deaths, a disparity that, a new clinical trial shows, vaping could reduce.³¹ Today’s smokers come disproportionately from lower education and income groups, the LGBTQ (lesbian, gay, bisexual, transgender, and queer or questioning) community,¹⁴⁷ and populations suffering from mental health conditions¹⁴⁸ and from other drug addictions.¹⁴⁹ Smoking accounts for a significant proportion of the large life expectancy difference between affluent and poorer Americans.^{150,151} For smokers with serious psychological distress, two thirds of their 15-year loss of life expectancy compared with nonsmokers without serious psychological distress may be attributable to their smoking.¹⁵² Vaping might assist more of these smokers to quit.^{148,153}

To the more privileged members of society, today’s smokers may be nearly invisible. Indeed, many affluent, educated US persons may believe the problem of smoking has been largely “solved.” They do not smoke. Their friends and colleagues do not smoke. There is no smoking in their workplaces, nor in the restaurants and bars they frequent. Yet 1 of every 7 US adults remains a smoker today.

Smoking will claim the lives of 480 000 of our fellow citizens this year alone. **AJPH**

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