



Cigarette Smoking Kills; Vaping E-Cigarettes Kills, Too.

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This briefing paper provides evidence-based guidance for policy development regarding electronic nicotine delivery systems (ENDS, such as e-cigarettes that heat a nicotine-containing e-liquid or e-juice without tobacco) and heated tobacco products (HTPs, which contain tobacco). It is particularly relevant in the light of at least 1,604 cases of e-cigarette, or vaping, product use associated lung injury (EVALI), including 35 vaping-related deaths, recently reported in 49 states of the US.^{1, 2, 3}

Despite the rapidly growing evidence of harm, these new products are promoted as supposedly safer alternatives to traditional cigarettes, reminiscent of how tobacco companies promoted cigarette filters⁴ and “light” or “low tar” cigarettes⁵ to give false reassurance to smokers that such innovations reduced their risks of health harms. Scientific and historical evidence has exposed these as industry deception.

Currently, Philip Morris International (PMI) admits that “the best choice any smoker can make is to quit cigarettes and nicotine altogether,” but it also says those who don’t quit should shift to ENDS and HTPs.⁶

Tobacco harm reduction and the 95%-safer factoid

The argument to shift smokers to vaping is what proponents of ENDS and HTPs refer to as tobacco harm reduction, but the European Respiratory Society (ERS) in a May 2019 position paper⁷ cites various arguments for why a harm reduction strategy shouldn’t be used as a population-based tobacco control strategy. These are echoed in a more recent article⁸ by Prof. Charlotta Pisinger, Denmark’s leading tobacco control expert and international expert on e-cigarettes, and Prof. Judith Mackay, a globally renowned tobacco control expert recognized by Time Magazine as one of the “most influential people in the world” for her role as a tobacco control campaigner.

To be valid, a tobacco harm reduction strategy should clearly demonstrate that it results in significantly reduced harm and does not itself cause harm. Vaping proponents often argue that ENDS and HTPs are generally harmless, claiming that e-cigarettes are “95% less harmful” than cigarettes and therefore safe to use. They say e-cigarettes only emit steam with “negligible other things,” citing industry studies that reportedly show a 90- to 95-percent reduction in exposure to toxins from e-cigarettes compared to cigarettes. Unfortunately, there is no credible scientific evidence to support such claims. In fact, several weeks ago, the World Health Organization (WHO) itself declared that e-cigarettes are “undoubtedly harmful” and not a safer alternative to regular cigarettes.⁹ Only Public Health England (PHE) has said ENDS (not HTPs) are 95% less harmful than cigarettes (note: because they contain tobacco, PHE considers HTPs more harmful than ENDS but does not attempt to quantify their level of harm). The Israel Cancer Association has openly criticized PHE’s “95% less harmful” claim.^{10,11}

The 95%-safer factoid, first cited by PHE in 2015, was already debunked by an analysis¹² in the British Medical Journal. It is based on a single paper by Nutt et al.¹³, who reported this figure based on the opinion of a small group of experts, who themselves acknowledged in their paper that there was a “lack of hard evidence for the harms of most products on most of the criteria” and that “there was no formal criterion for the recruitment of the experts.” In the words of an editorial¹⁴ of the prestigious medical journal, The Lancet, “the opinions of a small group of individuals with no prespecified expertise in tobacco control were based on an almost total absence of evidence of harm.” Also, the study by Nutt et al. was funded by Euroswiss Health, which has links to the tobacco industry, and Lega Italiana Anti Fumo (LIAF), which funds the e-cigarette research of one of Nutt’s co-authors, Riccardo Polosa, who also has ties to the tobacco industry. Polosa is past President and currently Chief Scientific Advisor to LIAF and serves as a consultant to an e-cigarette distribution company. The journal editors added a note at the end of the paper about the “potential conflict of interest” associated with this work. While more studies have been conducted since 2015, there remains no independent study that quantifies the degree of “less harm” of



these new products.

In contrast, the World Health Organization, Philippine Department of Health, Philippine Medical Association, Philippine Pediatric Society, National Cancer Society of Malaysia, Indian Ministry of Health and Family Welfare, Indian Council of Medical Research, Australian Government's National Health and Medical Research Council, Australian Medical Association, Royal Australasian College of Physicians European Public Health Association, European Respiratory Society, Irish Heart Foundation, Irish Cancer Society, Israel Cancer Association, Turkish Medical Association, Turkish Green Crescent Society, American Medical Association, American Academy of Pediatrics, American Academy of Family Physicians, American College of Physicians, American College of Obstetricians and Gynecologists, American Heart Association, American Lung Association, and various other national and international governmental and non-governmental organizations have examined the available evidence and decided to take a precautionary approach with regard to ENDS and HTPs.

More than 40 countries¹⁵ have already banned the sale of e-cigarettes/ENDS and emerging tobacco products such as HTPs. Among these are five ASEAN countries: Brunei, Cambodia, Lao PDR, Singapore, and Thailand. Others include Argentina, Australia, Brazil, East Timor, India, Kuwait, Taiwan, and Uruguay. Hong Kong is also considering a ban on these products.

Vaping: a cocktail of toxic and unknown chemicals, not just water vapor

Contrary to the misleading perception that ENDS and HTPs only generate steam or water vapor, these products actually emit chemical aerosols (smoke is also a chemical aerosol) composed of particulate matter suspended in gas. Even if temperatures applied are lower than in conventional cigarettes, heating e-liquids and/or tobacco results in pyrolysis or thermal decomposition without combustion and creates many of the same toxic chemicals found in cigarette smoke, and because there is a non-linear dose-response relationship between exposure and health risks, it remains unproven that lower exposure will equate to reduced risks or reduced harm.

Because tobacco is inherently toxic and contains carcinogens even in its natural form, the WHO has warned that all forms of tobacco, including HTPs, are harmful, and that there is no evidence to demonstrate that HTPs are less harmful than conventional tobacco products.¹⁶ Independent research on HTPs, including analysis of Philip Morris International's (PMI) own data submitted to the US Food and Drug Administration (FDA) on its flagship HTP, IQOS, has shown that HTPs release the same harmful constituents of conventional tobacco cigarette smoke, such as volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and carbon monoxide,¹⁷ and that while lower levels of some toxicants are delivered by HTPs compared to conventional cigarettes, there is no evidence to show that lower exposure results in lower risks of harm in humans as demonstrated by biomarkers and lung function in smokers that switched to IQOS.^{18, 19} A new study published earlier this year showed HTPs, ENDS, and conventional cigarettes are all toxic to human lung cells.²⁰

Note also that PMI reported levels for only 40 of the 93 harmful and potentially harmful constituents (HPHC) in the US FDA's list, and of the 53 not tested, 50 are carcinogens. In addition, levels of 56 other constituents, which are not included in the PMI or FDA lists of HPHCs, were higher in IQOS emissions; 22 were >200% higher and seven were >1,000% higher than in a standard cigarette's smoke, some of which are potentially toxic, while others have still undetermined effects.²¹

For these reasons, the US FDA's Tobacco Products Scientific Advisory Committee rejected PMI's claim that its IQOS HTP demonstrated any modified (reduced) health risk,²² and while the US FDA has permitted sale of IQOS in the US, it has clarified that this does not mean these products are safe or "FDA approved" or that PMI can legally make claims that IQOS is a modified risk tobacco product (MRTP).²³

Similarly, ENDS aerosols include fine particulate matter (PM 2.5),²⁴ as well as glycols, aldehydes, volatile



organic compounds (VOCs), polycyclic aromatic hydrocarbon (PAHs), tobacco-specific nitrosamines (TSNAs), toxic metals (lead, nickel, and chromium),^{25, 26} silicate particles and other elements. Dicarbonyls (glyoxal, methylglyoxal, diacetyl) and hydroxycarbonyls (acetol) also are thought to be important compounds in the aerosol. Many of these substances are toxicants that have known health effects resulting in a range of significant pathological changes.^{27, 28}

Available animal and human studies have identified serious health risks of ENDS liquids, flavors, aerosols, and solvents;²⁹ these include damage to cellular DNA,^{30, 31} blood vessels,³² lung cells,^{33, 34, 35, 36, 37, 38} and brain stem cells,³⁹ as well as cancer.⁴⁰ Various reports also show actual health harms linked to these products, such as asthma⁴¹ and other acute and chronic lung disorders,^{42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56} mouth and teeth disorders,⁵⁷ and seizures.⁵⁸ The US FDA and US Centers for Disease Control and Prevention (CDC) are currently investigating the role of e-cigarettes in some of these serious diseases.

At least two cases of acute pneumonia related to HTPs have been reported in Japan.^{59, 60}

Aside from nicotine, the ingredients of e-juice are propylene glycol, vegetable glycerin, and flavorings, which vapers claim are harmless and even approved (“generally recognized as safe”) for use in food. Unfortunately, this oversimplification fails to recognize that food-grade substances are not approved for inhalation, and the long-term effects of inhaling these substances and the by-products created by heating them are still largely unknown.

More than 15,500 unique e-liquid flavors were identified as available on the market in 2016-2017,⁶¹ double the number from three years prior.⁶² It is currently impossible to determine the health impacts of each flavor or combinations of flavors, but certain common flavoring chemicals used and found in e-liquids with and without nicotine have already been identified to be cytotoxic, particularly diacetyl (which is a cause of bronchiolitis obliterans or “popcorn lung”), cinnamaldehyde, vanillin, pentanedione, and acetoin, with increased toxicity noted for combinations of flavors.^{63, 64, 65} Researchers have also identified e-liquids as chemically unstable, with reactions occurring between flavorant and solvent components and forming new compounds after mixing and during storage of e-liquids.^{66, 67}

Nicotine: addiction, disease, and toxicity

Nicotine in itself is not a benign substance; in addition to its being highly addictive, it increases the risk of cardiovascular, respiratory, gastrointestinal, and reproductive and perinatal disorders, suppresses the immune response, and plays a clear role in carcinogenesis through cell proliferation, oxidative stress, apoptosis, and DNA mutation, as well as tumor growth, metastasis, and chemoresistance.⁶⁸ It has been shown to impair adolescent brain maturation with short-term and potentially severe long-term consequences for teen addiction, cognition, and emotional regulation.^{69, 70} Very recently, a 22-year-old man sued Juul Labs for his severe nicotine addiction (a Juul pod contains as much nicotine as a pack of cigarettes) that caused a massive hemorrhagic stroke, which required three brain surgeries and left him with permanent paralysis, speech impairment, and visual loss.⁷¹

Nicotine is also a highly potent poison. With growing e-cigarette use, more than 2,600 cases of nicotine poisoning, both accidental (mostly among young children) and intentional (among teens and adults), have been reported in recent years, mostly in the US, but also in Canada, South Korea, and 17 EU member states.^{72, 73, 74} Of these cases, at least 11 resulted in death.⁷⁵

Disturbingly, 25.7% of US 12th graders believed they were vaping “just flavors” and did not know there was nicotine in their e-liquids.⁷⁶



E-cigarette fires and explosions: physical injuries and deaths

On top of chemical toxicity, faulty vaping devices have also caused fires and explosions resulting in property damage and serious physical injuries (e.g. leg, hand, neck, and facial burns, other facial (eye, nose, mouth) trauma, and skull and neck fractures).^{77, 78} One such case in the Philippines, involving a 17-year-old was reported in 2018.^{79, 80} In the US alone from 2015 to 2017, there were an estimated 2,035 e-cigarette explosion and burn injuries presenting to US hospital emergency departments.⁸¹

At least two deaths have been documented in the US due to exploding e-cigarettes. The first such death was of a 38-year-old man, an experienced vaper, whose vape pen was made by a Philippines-based company.⁸² Earlier this year, a 24-year-old man was killed by his newly bought e-cigarette.⁸³

Secondhand vaping

Given the chemical profile of ENDS and HTP aerosols, there is a potential risk of harm from secondhand exposure, even when emissions are not clearly visible. Both the WHO and US National Academies of Sciences, Engineering, and Medicine (NASEM) have determined that there is conclusive evidence that exhaled e-cigarette aerosols increase airborne concentrations of particulate matter, nicotine, and some toxicants compared with background levels.^{84, 85} While very limited studies have examined the health risks of passive exposure to e-cigarette aerosols, a systematic review of evidence concluded that passive exposure to the air pollutants in ENDS aerosols is at concentrations associated with potential adverse health effects.^{86, 87} More recent studies indicate the potential for secondhand exposure to ENDS aerosols to exacerbate asthma among youths,⁸⁸ as well as induce cough, nausea/vomiting, throat and respiratory irritation or acute nicotine toxicity among children and adolescents.⁸⁹

It is therefore logical and appropriate that the WHO⁹⁰ and indoor air experts^{91, 92} have recommended that vaping be banned in places where smoking is banned. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Standard 62.1⁹³ includes e-cigarette emissions in its definition of environmental tobacco smoke.⁹⁴

E-cigarettes sustain nicotine addiction: not a proven smoking cessation tool

The harm reduction argument also tells smokers that they're incapable of quitting, and the ERS position paper is quick to state that it's based on an incorrect premise that smokers can't or won't quit smoking. In reality, majority of smokers want to quit, many of whom dislike being nicotine dependent and want to end their nicotine addiction. Worldwide, millions of smokers have quit with only social and behavioral support and without the use of nicotine replacement therapy (NRT) or any smoking cessation medication. Alternative nicotine-delivery products, such as e-cigarettes and HTPs, by rapidly delivering nicotine to the brain similarly to cigarettes, help to sustain rather than break nicotine addiction. A recent study among highly educated young adults even suggests that e-cigarettes are more addictive than conventional cigarettes.⁹⁵ Encouraging smokers to shift to vaping is tantamount to giving up on them. Instead, governments should be promoting tobacco cessation and relapse prevention to help smokers achieve long-term abstinence and freedom from nicotine addiction.

While some vaping proponents argue that vaping is an effective smoking cessation tool, even manufacturers of ENDS⁹⁶ and HTPs state that their products are switching products (from smoking conventional cigarettes to smoking electronic ones) and not intended to be smoking cessation products. IQOS is an acronym for "I quit ordinary smoking," indicating that the user is still smoking, albeit not regular cigarettes, and this was indeed the intention of its manufacturer: to keep people smoking. As one PMI salesman of IQOS put it, "It's not designed to help stop people from smoking. It's designed to be a replacement."⁹⁷



Some smokers say vaping helped them quit smoking cigarettes, but studies show that e-cigarette use does not necessarily lead to greater quitting or reduced consumption⁹⁸ but has dampened or hindered smoking cessation at a population level^{99,100} through dual use (alternating between cigarettes and e-cigarettes) or transitioning to vaping without quitting,^{101, 102, 103, 104, 105} while triple use (cigarettes, ENDS and HTPs) has even been reported among young South Korean adults using HTPs.¹⁰⁶ Even in the UK where e-cigarette use is heavily promoted, a 2006-2016 time series study¹⁰⁷ to assess the population-level impact of the use of NRT and e-cigarettes for harm reduction on cigarette consumption concluded that “if use of e-cigarettes and licensed NRT while smoking acted to reduce cigarette consumption in England between 2006 and 2016, the effect was likely very small at a population level.” This means that other tobacco control measures are responsible for the continuing decline of smoking in the UK.

Gateway to smoking and other drug use

Evidence^{108, 109, 110} is growing that vaping predicts future cigarette experimentation. Many ENDS devices are also used for vaping marijuana and other drugs.¹¹¹

Preventing youth uptake

Everyone agrees how important it is that youths should not be smoking or vaping. Even tobacco companies have said so publicly for decades, although they said otherwise in private. Internal tobacco company documents clearly show that they targeted teenagers, referred to 14-to-18-year-olds as “young adult smokers,” studied teen smoking patterns (differentiating between “presmokers”, “learners” and “confirmed smokers”), admitted that “the base of our business is the high school student,”¹¹² recognized that “the renewal of the market stems almost entirely from 18-year-old smokers”¹¹³ and that “today’s teenager is tomorrow’s potential regular customer,”¹¹⁴ and concluded that “the ability to attract new smokers and develop them into a young adult franchise is key to brand development.”¹¹⁵ In order to survive and prosper over the long term, tobacco companies have seen the need to capture the youth market, developing new products and brands that appeal to youths, because “younger adult smokers are the only source of replacement smokers... If younger adults turn away from smoking, the industry must decline, just as a population which does not give birth will eventually dwindle.”¹¹⁶

Regardless of what manufacturers say, it would be naïve to believe that these new products aren’t designed to be attractive to youths or non-smokers, even while appealing to current smokers. Conventional cigarettes allegedly aren’t designed or intended to attract youths and new smokers either, but, despite stringent regulations against underage sales, teen smokers are still able to obtain and use them. In December 2018, the US Surgeon General declared an epidemic of e-cigarette use among American youths after e-cigarette use increased 78% among high school students during the past year, from 11.7% in 2017 to 20.8% in 2018.¹¹⁷

Youths are naturally curious and want to try new things, especially sleek and hi-tech gadgets (which e-cigarettes are designed to be), and they’re more open to taking risks, which are aggressively downplayed in the case of vaping. For example, according to former US FDA commissioner Dr. David Kessler, “Juul says it doesn’t target kids, but its e-cigarettes pull them in, [because] the design makes it easier for young people to use.”¹¹⁸ Further, ENDS and HTPs, especially those using nicotine salts (pioneered by Juul), have succeeded in reducing nicotine’s irritation and harshness to the throat and created a smoother and more potent/addictive nicotine-laced aerosol for new users.

The use of vape flavors is also borrowed from the tobacco industry playbook: “It’s a well-known fact that teenagers like sweet products. Honey might be considered.”¹¹⁹ Examples of honey-flavored e-juice are honey graham, honey milk, milk and honey, honey crème, honeycomb berry, and organic honey. Fruit and candy flavors are also popular and attract new users, including youths, and reinforce the misperception that these products are “safe”.



Regulating ENDS and HTPs

Given that there is no evidence of long-term safety of these products, the precautionary principle should apply when regulating them. At one end of the regulatory spectrum is prohibiting the manufacture, promotion, distribution, sale, and use of ENDS and HTPs, which more than 40 countries have done. This is a logical approach, particularly where the regulatory framework or enforcement may be weak or problematic.

Some jurisdictions have opted to regulate these products by restricting their manufacture, promotion, distribution, sale, and use. HTPs, by virtue of their being tobacco products, should be subject to the same policy and regulatory measures as for all other tobacco products, as recommended by the WHO¹²⁰ and in line with the WHO Framework Convention on Tobacco Control (FCTC).¹²¹ ENDS, being similar to tobacco products, are regulated as tobacco products in at least 18 countries, while at least 29 countries regulate ENDS as pharmaceutical products.¹²²

When regulated as tobacco products, restrictions include prohibiting their use in public places to protect people from secondhand exposure to ENDS and HTP emissions, advertising and promotion bans to reduce uptake by youths, and packaging and health warning requirements. For example, pictorial health warnings are required on all tobacco packages, including HTPs and ENDS, in South Korea (50% of the front and back of packaging of e-juice or liquid nicotine bottle),¹²³ Tajikistan (75% of the front and back of all tobacco product packaging including e-cigarette packaging),¹²⁴ and New Zealand (75% of the front and 100% of the back of the package plus standardized packaging for all tobacco products, including HTPs).

Conclusions

E-cigarettes are not harmless and can kill people. Whether they are less harmful and how much less harmful compared to cigarettes is still undetermined. E-cigarette devices and their use are attractive even to youths. While strengthening proven tobacco control measures to help smokers quit, strong precautions must be taken to prevent a new epidemic.

About SEATCA

SEATCA is a multi-sectoral non-governmental alliance promoting health and saving lives by assisting ASEAN countries to accelerate and effectively implement the evidence-based tobacco control measures contained in the WHO FCTC. Acknowledged by governments, academic institutions, and civil society for its advancement of tobacco control movements in Southeast Asia, the WHO bestowed on SEATCA the World No Tobacco Day Award in 2004 and the WHO Director-General's Special Recognition Award in 2014.

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