E-cigarettes:
Evidence and policy options for Washington State

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Executive summary

This report was researched and written by a team from the University of Washington School of Public Health and circulated among subject matter experts for review.

E-cigarettes aerosolize potentially harmful chemicals

Electronic cigarettes (e-cigarettes) are nicotine delivery devices that aerosolize nicotine and other chemicals to simulate the sensation of smoking a combustible cigarette. E-cigarettes were developed with the goal of mimicking the efficient nicotine delivery system of a conventional cigarette without the significant and harmful effects of tobacco smoke. The chemical composition of e-cigarettes can include metals, tobacco byproducts, volatile organic compounds, flavor agents and nicotine. Some of the contents and inhaled byproducts of e-cigarettes and vaping product liquids are carcinogenic or contain toxic substances. Nicotine is a highly addictive product to which children, adolescents, and young adults are particularly vulnerable. Unlike combustible and smokeless tobacco products, the federal government does not currently regulate e-cigarettes; therefore, designs and ingredients vary greatly from brand to brand, and even within brands.

E-cigarettes are inexpensive relative to cigarettes

E-cigarette prices are so low that the average daily e-cigarette user spends about $33 per month compared to $150-200 spent by a pack-a-day conventional cigarette smoker. One recent study found that increasing e-cigarette prices would reduce consumption by youth and adults. This mirrors findings of numerous economic studies published in peer-reviewed journals that demonstrate price increases, usually from taxes, reduce both adult and underage cigarette smoking. Results from these price elasticity studies show that every 10 percent increase in the real price of cigarettes reduces cigarette consumption overall by 3-5 percent, among young adults smokers by 3.5 percent, and among children under 18 years by 6-7 percent.

E-cigarette use among youth tripled between 2011-2013

A significant increase in e-cigarette use in the US has been spurred by marketing that promises a “safe” product, especially in comparison to other tobacco products. Perhaps as a result of this marketing, which includes product designs – like candy flavored e-cigarettes – that appeal to youth, e-cigarette use tripled among high school students between 2011 and 2013, and there is now evidence that **e-cigarettes surpass conventional tobacco products in popularity among youth**. Relative to combustible products, e-cigarettes are probably less dangerous, but there is little evidence to support the claim that there is no risk of harm.

The jury is still out on the efficacy of e-cigarettes as a smoking cessation aid

Harm reduction in public health consists of a set of strategies to minimize the risk associated with certain behaviors or use of drugs. As a harm reduction tactic, e-cigarettes hold promise. However, while the inhaled compounds associated with e-cigarettes may be fewer and less toxic than conventional cigarettes, public health officials still advise caution. **There is no evidence that e-cigarettes are a more effective cessation aid than the nicotine patch**. Other research points to a **potential role of e-cigarettes as an entree to other, more harmful tobacco**

products, particularly when used by children, adolescents, and young adults. For example, in 2014, the Centers for Disease Control and Prevention (CDC) released a study that documented the surge in e-cigarette use among school-aged youth and highlighted the possibility that use of these products could serve as a "gateway" to combustible products.

Nicotine is a highly addictive drug

Studies of the developing brain provide substantial evidence that **children, adolescents and young adults are especially vulnerable to nicotine addiction**. Exposure to nicotine at a young age leads to an increase in nicotine receptors in the brain, and it is these receptors that cause dependency. Adult brains (ages 26 and older) are generally unable to create these nicotine receptors. As a consequence, **virtually all daily smokers will have smoked their first cigarette before the age of 26, and nearly 90 percent will have started before the age of 18**.

The precautionary principle suggests that, in the absence of evidence assuring the safety of a product, policymakers should act conservatively in protecting consumers. Fortunately, numerous tobacco control policies have already been tested on the national, state and local levels – resulting in an estimated 8 million lives saved. These include:

- Retail licensing
- Taxation, and use of tax revenue to reduce use and offset associated healthcare costs
- Restrictions on age of purchase
- Labeling and disclosure requirements
- Restrictions on product flavorings
- Requirements for child-resistant packaging
- Limitations on internet sales
- Regulation of marketing
- Restricting use in public and/or indoor places

Strength of evidence supporting policy options

We adapted the Washington State Board of Health's "Health Impact Review" guidelines to synthesize the research findings related to tobacco and e-cigarette regulation. We assume for the purposes of this paper that many tobacco-related findings (i.e., the efficacy of raising tobacco taxes for reducing smoking prevalence) are generalizable to e-cigarettes. We created a graded scale to communicate strength of evidence.

Grading system

A	B	C	D
At least 10 well-designed studies support the association	At least five well- or appropriately-designed studies support the association	At least two studies support the association	Evidence is mixed, with more studies showing a negative association

Strength of evidence behind e-cigarette policy options

Policy option	Strength of evidence
Tobacco Retail licensure	**Score: B** *Several small studies support the efficacy of licensure laws in reducing smoking prevalence and improving health outcomes.*
Tax	**Score: A** *Numerous large, well-designed studies support the efficacy of taxation in reducing smoking prevalence and improving health outcomes.*
Age of purchase	**Score: A** *Significant evidence demonstrates that preventing youth initiation will result in a reduced smoking prevalence and improved health outcomes.*
Labeling and disclosure	**Score: B** *A number of well-designed studies demonstrate that tobacco product labeling is positively associated with consumer knowledge of health effects.*
Flavored products	**Score: A** *A number of well-designed studies show that flavored products appeal to youth, who are vulnerable to nicotine addiction.*
Child-resistant packaging	**Score: B** *Child-safe packaging requirements for other potentially dangerous products resulted in a decline in child mortality as a result of poisoning*.
Internet sales	**Score: C** *There is insufficient evidence about the efficacy of laws regulating online sales of conventional products. To date, there is little evidence that e-cigarettes are being purchased online by minors.*
School policies	**Score: C** *There is substantial evidence that tobacco use norms are highly influential in youth initiation, but there is no specific evidence demonstrating that primary and secondary school policies result in decreased prevalence.*
Marketing restrictions	**Score: A** *There is abundant evidence of a dose-response relationship between exposure to tobacco marketing and use, including in convenience store settings.*
Cessation	**Score: C** *While there is emerging evidence that e-cigarettes may help reduce the use of more harmful tobacco products, we do not yet know if there are effective in treating tobacco dependence compared to other evidence-based cessation methods.*

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0.0 Background

The University of Washington's School of Public Health (UW SPH) is ranked sixth in the nation among schools of public health[1] and houses more than 30 research centers, as well as numerous degree and certificate programs.[2] In 2014, state legislator and UW SPH clinical faculty member Gerry Pollet (Washington State House District 46) requested a white paper to accompany the introduction of a bill to regulate e-cigarettes during the 2015 Washington State legislative session. A team of UW SPH faculty, staff and students drafted this report and circulated it among subject matter experts for review.

In addition to considering individual-level health effects of e-cigarettes in this paper, the UW team examined the population-level repercussions of policy interventions. Tobacco control efforts, such as mass media educational campaigns and smoke-free policies, are credited with saving 8 million American lives since 1964, the publication year of first US Surgeon General's Report detailing the harms of cigarette smoking.[3] E-cigarettes exist along a continuum of nicotine delivery vehicles, the most common of which are combustible tobacco products like cigarettes, cigars and cigarillos. These combustible products are the leading cause of preventable disease, disability and death in the United States (US) and worldwide.[4]

Although US cigarette smoking rates have generally declined in recent decades – from a high of 43 percent in 1964 to about 18 percent in 2014 – disparities in tobacco use and related health effects persist; some communities continue to disproportionately use tobacco and suffer from tobacco-related disease.[5] These subgroups include people with low educational attainment, people with mental illness, the lesbian, gay, bisexual and trans* (LGBT) community, and people living in the Southern and Midwestern United States. Rural residency is also associated with higher smoking rates.[6] Despite the life-saving tobacco control efforts, an estimated 20 million US deaths between 1964 and 2012 were still attributable to smoking, increasingly concentrated in these subpopulations.[7] Youth are particularly susceptible to nicotine addiction, with 90 percent of adult smokers initiating use by the age of 18 and virtually all by the age of 26.[5]

Thanks to the well-funded Washington State Tobacco Prevention and Control Program and strong tobacco control policies, between 1999-2008 the smoking rate in Washington fell from 23 percent to 14.7 percent; during this period Washington rose from being ranked 22nd to 3rd in terms of the lowest smoking rate among all US states. Following budget cuts to the Program in 2008, prevalence increased to 16.1% by 2013.[8]

As at the national level, numerous tobacco use disparities persist in Washington State, with some populations of color (African Americans, Native Americans and Alaska Natives, and Pacific Islanders) and sexual minorities more likely to smoke than other groups. People with lower educational attainment (i.e., some high school, GED) smoke at higher rates compared to those who have graduated from high school and attended or completed college, and those who live in poverty smoke at a greater rate than those with higher income.[9]

Given the many public health concerns about combustible tobacco products, e-cigarettes are met with fierce debate among those in the tobacco control and prevention field. Some experts believe e-cigarettes hold promise as a harm reduction strategy, shifting tobacco users away from deadly combustible cigarettes, while others worry that these products serve as a "gateway" to regular use, and further normalization, of cigarettes and other conventional tobacco products. [10] This white paper is intended to synthesize the evidence to provide Washington State legislators an impartial account of benefits, harms, opportunities and policy remedies.

1.0 What are e-cigarettes?

Since 2007, when they were introduced to the US market, the popularity of electronic cigarettes (known as e-cigarettes or electronic nicotine delivery systems (ENDS)) has increased.[11] Chinese pharmacist Hon Lik invented the device in its current form in 2003, intending its use for smoking cessation.[11] E-cigarettes are nicotine delivery devices that aerosolize nicotine and other chemicals to simulate smoking a combustible cigarette.[12] E-cigarettes do not involve tobacco combustion; rather, nicotine and the other components are aerosolized prior to inhalation.[13] The US patent application describes the e-cigarette device as "an electronic atomization cigarette that functions as substitutes [*sic*] for quitting smoking and cigarette substitutes."[11]

1.1 E-cigarette design

E-cigarettes were developed to mimic the efficient nicotine delivery system of a conventional cigarette without the significant harmful effects of tobacco smoke.[12] Unlike combustible and smokeless tobacco products, the federal government does not currently regulate e-cigarettes; therefore, engineering and ingredients vary greatly from brand to brand, and even within brands.[14] The US Food and Drug Administration (FDA) does not currently oversee the evaluation of e-cigarettes for consumer safety, health effects, or efficacy in cessation treatment. (See Section 6.1 for more information about federal regulation of tobacco products.) Without such oversight, what little is known about e-cigarettes is based on relatively few small-scale studies.

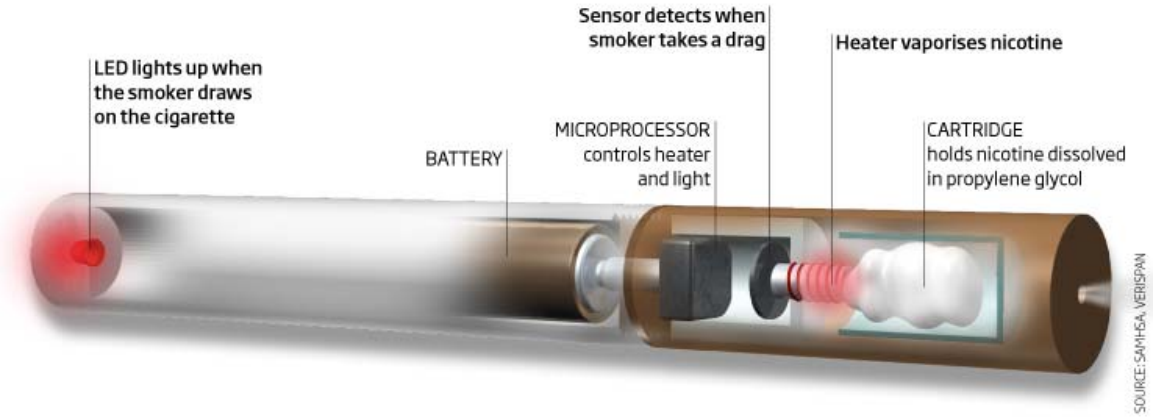
Most e-cigarettes consist of the following[14]:

- A battery with which to heat the e-cigarette liquid
- E-cigarette liquid (e-liquid), which usually contains nicotine in a propylene glycol or glycerin solution; many of the liquids also add flavoring (options include tobacco, menthol, coffee, fruit, candy, soda and alcohol[11])
- An atomizer or cartomizer (combined cartridge and atomizer), which heats the e-liquid so that it becomes aerosolized, and may house a microprocessor, a metal coil and a wick
- A light emitting diode at the end of the e-cigarette, mimicking the appearance of a lit combustible cigarette

A diagram of these components is shown in Figure 1. The chemical composition and byproducts of e-cigarettes include various heavy metals, glycerin or other glycols, and a class of hazardous and potentially carcinogenic compounds called carbonyls (i.e., formaldehyde and acetaldehyde), as described in detail in Section 4.3.

As e-cigarettes have grown in popularity, manufacturers, 90 percent of whom are based in China, have altered their designs (e.g., replaceable batteries, new e-liquids, digital displays) to create new and unique products.[15] Second generation e-cigarettes, with higher voltage batteries, may deliver nicotine more effectively than their predecessors.[16]

Figure 1: Components of a typical e-cigarette

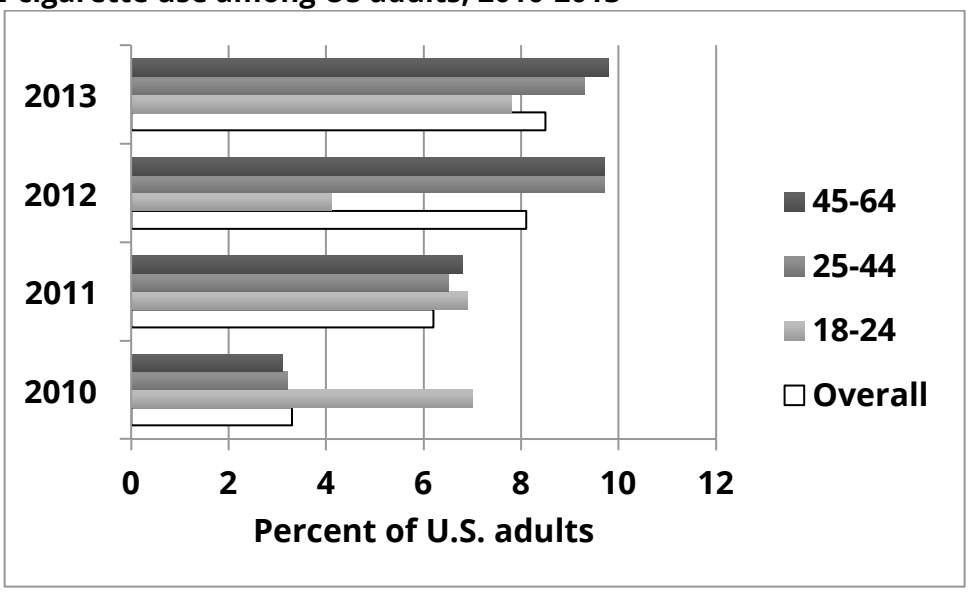


2.0 E-cigarette use

2.1 National

Public health surveillance data on e-cigarette use and related behaviors remain scarce because the product is so new.[17] Despite uncertainty regarding the health effects of e-cigarettes, experimentation and demand among US adults and youth has increased. “Ever use,” a category that includes anyone who has ever used e-cigarettes, more than doubled among all adults during 2010–2013, from about 3 to 8 percent (see Figure 2).[18]

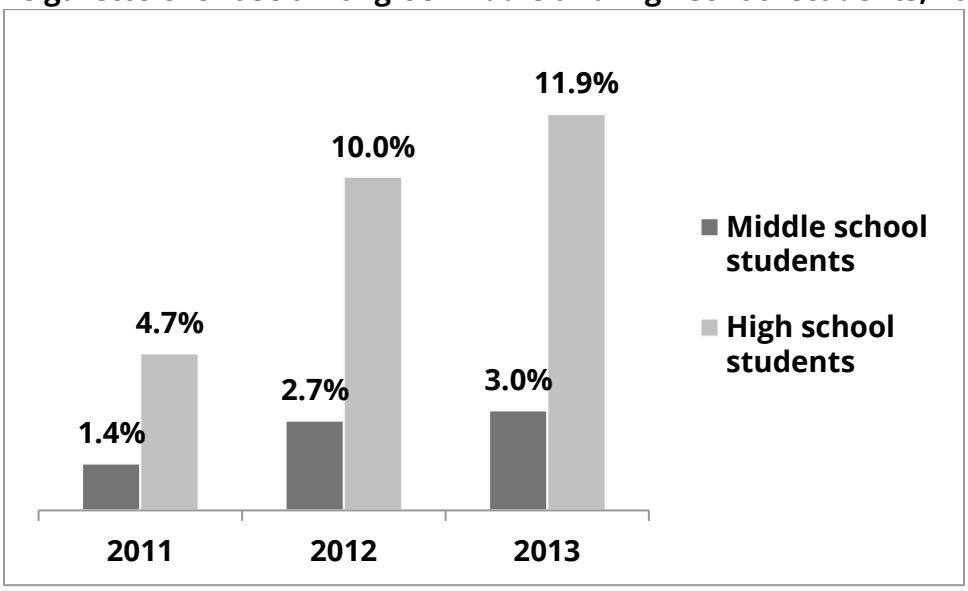
Figure 2: E-cigarette use among US adults, 2010-2013



Source: King BA, Patel R, Nguyen KH, Dube SR. Trends in Awareness and Use of Electronic Cigarettes Among US Adults, 2010-2013. *Nicotine & Tobacco Research*. 2014. doi:10.1093/ntr/ntu191.

E-cigarette experimentation and recent use also tripled among US middle and high school students between 2011 and 2013 (see Figure 3).[19] Many of these teens could be considered "nonsmokers;" an estimated 160,000 students who reported using e-cigarettes had never used conventional cigarettes in 2012, and by 2013 this number had increased to 250,000.[17] In 2014, e-cigarettes surpassed conventional products in popularity among secondary school students.[20]

Figure 3: E-cigarette ever use among US middle and high school students, 2011-2013



Source: CDC, Youth Tobacco Survey, 2014.

2.2 Washington State

According to the 2012 Healthy Youth Survey, 7 percent of Washington State youth reported having used an e-cigarette.[21] This was the first year to measure prevalence of e-cigarette use among children Washington, so it is not yet possible to compare this figure to previous years. No data are currently available for adult e-cigarette use in Washington State.[22]

By comparison, 17 percent of Washington State adults, or 892,000, were current cigarette smokers in 2012, with lower prevalence in King County (14 percent).[8] Nearly 8,000 deaths are attributed to tobacco product use or secondhand smoke exposure in Washington State each year; the annual tobacco-attributed death toll surpasses the sum of all deaths caused by car accidents, alcohol, drug use, suicide, homicide, HIV/AIDS and fires.[23]

3.0 The e-cigarette business

3.1 Sales

The e-cigarette market has grown rapidly over the past few years, accompanied by an increase in marketing. By 2014, global consumers spent $3 billion on 466 separate brands.[24] E-cigarettes are being marketed widely through television commercials, sports and cultural event sponsorship, celebrity endorsement, social networking, online advertising, point-of-sale displays, discount pricing, and product innovation.[24] A recent study counted 7,764 unique e-cigarette flavors – while the role of flavoring in market uptake is just starting to be studied, past cigarette marketing trends and expert opinion indicate candy-like flavors typically entice youths to begin use.[24]

Unlike conventional cigarettes, which are heavily taxed in most states, e-cigarettes are currently untaxed in the US (with the exception of two states), allowing retailers to sell them at lower prices.[25] Because of price differences created by this tax imbalance, e-cigarettes are promoted as a cheaper nicotine alternative to conventional cigarettes.[25] Indeed, the average daily e-cigarette user spends about $33 per month compared to a pack-a-day cigarette smoker who spends about $150-200 per month.[26] One recent study found policies increasing e-cigarette prices were likely to reduce e-cigarette consumption among youth and adults.[27] This mirrors findings in numerous economic studies published in peer-reviewed journals documenting that price increases, usually from taxes, reduce both adult and underage smoking. See Section 6.2.2 for more information on tobacco product taxation.

E-cigarettes are a lucrative business; total revenues doubled to over $1.5 billion from 2012 to 2013.[28] A significant portion of the e-cigarette trade is conducted online, although it is difficult to ascertain the exact volume, since e-cigarette sales are mostly unregulated. Researchers in January of 2014 estimated Internet sales comprise about 30–50 percent of total e-cigarettes sold.[29] Some countries have imposed restrictions on the sale of certain types of e-cigarettes[24], but the availability of all varieties of e-cigarettes on the Internet has made enforcement difficult.[29]

3.2 E-cigarette marketing and related issues

E-cigarettes are marketed heavily in both traditional (e.g., television and print) and digital modalities, with messages that often feature celebrities and ads that bear striking similarities to those advertising conventional tobacco products (see Figure 3).[30,31,32,33] Ads portray e-cigarettes as safer alternatives to conventional smoking (see Figure 4), as useful for quitting smoking and reducing cigarette consumption, and as a way to circumvent smoke-free laws by enabling users to "smoke anywhere," even despite lack of evidence to support these claims.[30] Because e-cigarettes are not currently subject to the same marketing restrictions as conventional cigarettes, researchers and the public health community have expressed concern regarding potential consequences of rapid expansion of e-cigarette marketing, including:

- Increased e-cigarette initiation and subsequent nicotine addiction
- Dual use of both electronic and combustible cigarettes, given mounting evidence that using e-cigarettes in addition to regular cigarettes may decrease quitting both types (see Section 5.0)
- False belief in efficacy for smoking substitution or cessation[34]
- Potential role in conventional cigarette uptake[35]
- Renormalization of smoking

Figure 3: Modern e-cigarette versus early conventional cigarette advertising

Source: Campaign for Tobacco-Free Kids.
Available at: http://www.tobaccofreekids.org/tobacco_unfiltered/post/2013_10_02_ecigarettes

Figure 4: E-cigarettes marketed as healthier alternatives to cigarettes, especially to disproportionately high cigarette user groups

Source: Stanford University Research into the Impact of Tobacco Advertising.
Available at: http://tobacco.stanford.edu/tobacco_main/

All three major US tobacco companies (Altria/Phillip Morris, RJ Reynolds, and Lorillard) have acquired e-cigarette brands, substantially increasing the industry's advertising expenditures. For example, after Lorillard purchased Blu in 2012, advertising expenditures for the product line increased from $2 million in 2011 to $14 million in 2012.[29]

Television remains the primary media channel through which advertisers reach US youth with messages, since there are no restrictions on TV advertising of e-cigarettes as there are for conventional cigarettes. Although e-cigarette advertising on television may be designed to increase use by adult US audiences, it may also result in considerable youth exposure.[36] For example, one study found youth exposure to television e-cigarette advertisements, measured by target rating points, increased by 256 percent from 2011 to 2013.[36] This is consistent with previous research that demonstrates exposure to pro-tobacco advertisements is associated with smoking intentions, so much so that a "dose-response" relationship exists between exposure to marketing and tobacco use.[5] This association is characterized by an increase in use in proportion to exposure.[37]

3.2.1 Marketing and disparate health outcomes

Targeted marketing strategies, such as sponsorship of events (see Figure 5 below), and grants to community organizations, are thought to contribute to disparities in tobacco use and health outcomes.[38, 39] Tobacco use and related health disparities have been documented by race and ethnicity, level of acculturation (i.e., first generation vs. third generation immigrant),

socioeconomic status, educational attainment, and sexual orientation.[5] People living with mental illness are 70 percent more likely to use tobacco, consuming 3 out of every 10 cigarettes smoked, and are therefore more likely to suffer tobacco-related disease or death.[40] While it is too soon to identify the full range of disparities related to e-cigarette use, or their consequences, a 2014 CDC report suggests that they may be similar to tobacco use[41]:

- 4.5 percent of LGBT adults use e-cigarettes, compared to 1.9 percent of heterosexuals.
- Adults who have not completed high school and/or have a GED use e-cigarettes at the highest rate (3.1 percent), when compared with those with some college education but no diploma (2.5 percent), an undergraduate degree (1 percent) or a graduate degree (0.5 percent).
- People with annual incomes under $20,000 smoked e-cigarettes the most (2.5 percent) of any income group, and people with annual incomes over $100,000 used e-cigarettes the least (1.4 percent).

Figure 5: Example of targeted e-cigarette marketing to the LGBT community

Source: Varporzone blog. http://blog.vaporfi.com/vaporzone-is-proud-to-be-a-sponsor-at-the-2014-miami-beach-gay-pride-festival/ Accessed January 17, 2015.

4.0 Health effects and consumer safety

4.1 Health effects

Tobacco is the leading known cause of preventable disease, disability and death in the United States and worldwide. The burning of tobacco products emits as many as 7,000 compounds, many of which are tied to morbidity and mortality. Smoking negatively affects all human organs, and a 2006 Surgeon General's Report found there is no safe level of exposure to secondhand smoke.[42] E-cigarettes, then, exist on a continuum of risk; relative to conventional cigarettes, they are almost undoubtedly *safer* because there is no combustion that occurs. However, it is too soon to declare them safe, and we do not yet know enough about whether their use will produce widespread population-health effects, either positive or negative.

E-cigarettes are often marketed as containing no harmful ingredients.[43] In medicine and public health, risk from pharmaceuticals and related products can be viewed in *absolute* terms, or as *relative* to other, more harmful products. For example, while the inhaled compounds associated with e-cigarettes are fewer and less toxic than those from conventional cigarettes, data regarding e-cigarette use are insufficient to determine the degree of harm to the individual user, or the relative safety, compared with traditional cigarettes.[13] Proponents of e-cigarettes may believe they are safe alternatives to conventional cigarettes; however, harmful ingredients have been documented in many e-cigarettes (as described in Section 4.3), albeit at significantly lower levels than conventional cigarettes.[44]

E-cigarette use may reinforce social norms regarding conventional tobacco use, or delay cessation among smokers of conventional cigarettes.[36] This is of particular concern with regard to youth, among whom e-cigarette use is increasing.[45] Previous longitudinal studies have shown that adolescents who underestimate the risks of long-term tobacco use are more likely to initiate smoking behaviors.[46] This phenomenon, in which users are aware of the risks as they apply to others (but believe these risks will not apply to themselves), is known as *optimism bias.*[47] Because young people may perceive e-cigarettes as even less harmful than conventional cigarettes, those with little previous experience with tobacco are at risk for nicotine addiction through experimentation with e-cigarettes.[45]

Nationally, exposure to secondhand smoke from conventional cigarettes contributes to the deaths of about 40,000 people per year from heart disease, stroke, lung cancer, and other respiratory diseases.[48] Thirdhand exposure – defined as exposure to nicotine, particulates or other chemicals that result from second-hand smoke deposits on surfaces (i.e., walls, floors, furniture and clothing) through ingestion, inhalation and skin contact – also occurs with e-cigarette use.[49] The risk associated with secondhand and thirdhand e-cigarette aerosol has just begun to be studied. However, preliminary evidence suggests that both are potentially hazardous.[12] The lack of combustion likely reduces toxicant exposure for e-cigarette users compared to traditional cigarettes, but users and bystanders may experience secondhand exposure through direct physical contact with product components and inhalation of secondhand aerosol from nearby e-cigarette use.[13, 50]

4.2 Nicotine addiction

Studies of the developing brain provide substantial evidence that children, adolescents and young adults are especially vulnerable to nicotine addiction. Exposure to nicotine at a young age leads to the generation of more nicotine receptors in the brain, which causes dependency symptoms. Adult brains (over the age of 25) are generally unable to create these nicotine receptors. As a consequence, virtually all daily smokers will have smoked their first cigarette before the age of 26, and nearly 90 percent will have started before the age of 18, when young people are legally able to purchase tobacco products.[51]

On this basis, the FDA has expressed concern that the use of e-cigarettes may increase the prevalence of nicotine addiction, especially among youth, and could serve as a “gateway” to other tobacco products, including conventional cigarettes.[52] An unintentional consequence

associated with e-cigarette use could be the addiction of previously non-cigarette smoking individuals.[53] Additionally, e-cigarettes could cause cigarette smokers to maintain their addictions.[54] Because nicotine is one of the most addictive known substances, the potential (absolute risk) for addiction to nicotine must be considered.[52]

4.3 Consumer safety

Since e-cigarettes are not federally regulated, their chemical make-up is largely unknown. A growing number of researchers have attempted to measure content and emissions, but their only option is to examine products already on the market rather than screening proposed products for safety. Consumers and those exposed to secondhand aerosol from e-cigarettes have no way of knowing what ingredients are being aerosolized, and advertised nicotine levels may not correspond with actual content.[55] Moreover, nicotine concentration in e-liquid does not often match the aerosol concentration, although most studies have concluded the amount of nicotine and other chemicals is far less than what is found in combustible products, and therefore less likely to lead to toxicity. [55,56] A 2010 evaluation of e-cigarettes found that while packaging contained information about how to use the devices, there was no accounting of ingredients or risks.[57]

The chemical composition of e-cigarettes can include metals, tobacco byproducts, volatile organic compounds, flavoring agents and nicotine. Table 1 presents information on risks associated with chemical constituents commonly found in e-cigarettes.

Table 1: Aerosolized components of e-cigarettes

Component	Purpose	Risks
Propylene glycol	Synthetic solvent mixed with nicotine in cartridge to maintain moisture	None known. Approved as a "generally safe" food additive by FDA, but not tested or approved for human inhalation.[58] May cause upper respiratory irritation.[59]
Vegetable glycerin	Liquid mixed with nicotine in cartridge to maintain moisture	Two reported cases of lipoid pneumonia resulting from inhalation.[60] Vegetable glycerin is deemed safe for consumption in food by the federal government, but effects on inhalation are unknown.[61]
Propylene glycol byproducts/carbonyl compounds: acetaldehyde, formaldehyde, propylene oxide, acrolein and glyoxal	Carbonyls are created when propylene glycol comes into contact with heated nichrome wire[62]	Carbonyls are generally considered harmful to humans and can lead to irritation of the mouth, throat and upper airway. Formaldehyde is a confirmed carcinogen, while acetaldehyde is classified as a possible carcinogen.[63] The concentration of carbonyls depends on the type of e-liquid and the e-

		cigarette battery voltage.[62]
Nicotine	Stimulant	A highly addictive chemical that causes increase in heart rate and blood pressure with common use. Nicotine poisoning can occur from ingestion, absorption, or inhalation and causes dizziness, nausea, vomiting, confusion, convulsions, and can lead to death by respiratory arrest.[64]
Other tobacco byproducts (alkaloids, particulates, and nitrosamines)	Formed when curing tobacco and found in e-fluid flavoring	Can cause cancer with high level or repeated inhalation exposures
Metals, including tin, chromium, silver, copper, aluminum and nickel, and many others	Present in cartomizer or atomizer filament, wick and silicate head at similar levels to combustible cigarettes[65]	Exposure to metals can lead to skin, eye respiratory tract, and gastrointestinal irritation.[66] Possible damage to the reproductive system from exposure to chromium, which is also a known carcinogen.[67] Aluminum may contribute to risk of Alzheimer's disease.[68]

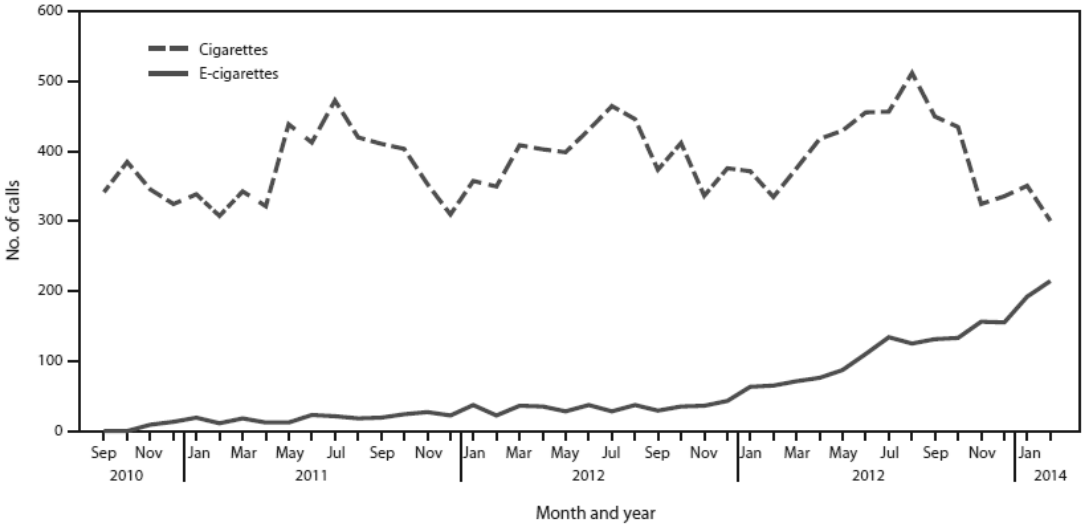
While e-cigarette aerosol exposure is likely to be less harmful than conventional cigarette smoke, it cannot be considered safe. There is evidence of inconsistent and faulty design across e-cigarette manufacturers. A December 2014 *New York Times* article detailed the lax safety requirements found in some of the Chinese businesses that manufacture 90 percent of the world's e-cigarettes,[69] while a 2010 study of six brands found that most leaked nicotine solution, and that it was difficult to avoid physical contact with the liquid when operating the device. The same study also found defective parts, such as dead batteries and mistimed indicator lights (used to signal when the battery is low or if the user has inhaled too many times).[57]

The advent of refillable e-cigarettes has created a new set of dangers. Consumers are now able to purchase large quantities of nicotine liquid – as much as 720 mg in one container – which, if consumed all at once, could easily lead to death. Approximately 40-60 mg of e-liquid can be fatal for a child. There is currently no federal requirement for childproof packaging of e-liquid containers.[70]

Since the introduction of e-cigarettes, US Poison Control Centers, an organization that includes all 55 state and regional poison control centers, reported exponential increases in calls related to accidental e-cigarette-related toxic exposure among children under 5 years old (see Figure 5).[71] The first death of a child from nicotine poisoning occurred in December of 2014.[72] Across the country, poison control centers received 3,957 calls in 2014, almost triple the number seen

in 2013 (1,351 calls), and over 500% increase since 2012 (617 calls).[73] Washington State Poison Center recorded at least 56 children treated for nicotine poisoning in 2014, and received over 170 calls concerning e-cigarettes or liquid nicotine during that year.[74]

Figure 6: Number of calls reported to US Poison Centers related to cigarette and e-cigarette poisoning in the US



Source: CDC, MMWR 2014

5.0 Role in smoking cessation

Tobacco cessation approaches typically include some combination of nicotine replacement therapy (i.e., NRT, patches, lozenges, etc.), pharmaceutical therapy, such as varenicline (Chantix®) and bupropion, and in-person or telephone counseling. Specific, evidence-based guidelines for clinicians are available through the US Public Health Service.[75] Table 2 displays the relative efficacy of cessation methods as summarized in the 2008 US Public Health Service Guidelines on Treating Tobacco Use and Dependence.

Table 2: Relative efficacy of cessation treatment methods

Method	Likelihood that treatment will work (e.g., 1.7 means 70% greater chance; 2.0 means double the likelihood of quitting)
Smoking cessation counseling	
Individual	1.7
Group	1.3
Telephone quit line	1.6
Physician intervention	
Brief advise to quit vs. no care or usual care	1.3
Brief counseling vs. no advice or usual care	2.2

Nicotine replacement	
Nicotine patch	1.9
Nicotine gum	1.6
First line drugs	
Bupropion	2.0
Varenicline (Chantix®)	3.1

Source: Adapted from National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health. *The Health Consequences of Smoking—50 Years of Progress: a Report of the Surgeon General*. Atlanta (GA): Centers for Disease Control and Prevention (US); 2014.

Although research was scarce until very recently because e-cigarettes have been on the market for such a short time, more evidence has accumulated about the role of e-cigarettes in smoking cessation. The Cochrane Collaboration issued a rigorous analysis of published research on this topic in December of 2014. This review not only assessed findings across studies, but also the quality of the studies themselves, and reached the following conclusions[76]:

- Compared with use of e-cigarettes without nicotine, e-cigarettes containing nicotine may boost the chances of long-term cessation. (Note that a comparison has not yet been made to other smoking cessation treatment options.)
- Use of e-cigarettes was associated with a reduction in combustible use by half.
- There are no increased health risks associated with e-cigarette use compared to smokers who do not use e-cigarettes.
- There is not enough evidence to determine if e-cigarettes are a better cessation aid than the nicotine patch.

Studies of large numbers of people attempting to quit smoking conventional cigarettes using a variety of strategies (counseling, NRT, pharmaceuticals, and e-cigarettes) are needed to demonstrate comparative efficacy of e-cigarettes as a cessation aid. The US Public Health Service, which serves as the authority on smoking cessation, does not yet include e-cigarettes as a treatment for tobacco dependence in its clinical practice guideline.[77] However, a few studies have shown some promising results, and the American Heart Association has come out with a controversial recommendation that e-cigarettes be offered to patients who have failed to quit smoking using FDA-approved medications.[78]

A cross-sectional study of 5863 British adults published in 2014 compared use of e-cigarettes as a cessation aid to traditional nicotine replacement therapy, finding that in the absence of professional help, e-cigarette use was more predictive of successful quitting among conventional cigarette smokers.[79] Less promisingly, a randomized control trial of 657 New Zealand residents found only modest (and statistically insignificant) evidence for e-cigarettes being an effective smoking cessation tool.[34] A 2013 longitudinal study in four countries (the US, United Kingdom, Canada, and Australia) concluded the use of e-cigarettes was not associated with quitting conventional cigarettes.[80] Another US longitudinal study examining Midwestern middle schoolers found e-cigarette users were heavier conventional cigarette smokers and less likely to stop smoking cigarettes. The study ultimately concluded e-cigarettes were more likely

to encourage conventional cigarette smoking than to assist with cessation.[81] As longitudinal study design is considered more scientifically valid, the latter studies may be more reliable than the previous cross-sectional studies.

Despite this mixed evidence, nearly two in three (64 percent) e-cigarette products claim a smoking cessation benefit in their packaging and marketing.[30] Most studies conclude further research is needed to test the role of e-cigarettes in smoking cessation, especially since e-cigarette products are changing quickly, and many of the findings from studies of older products may not be relevant to the assessment of newer products.[11]

At its annual meeting in November 2014, the American Public Health Association adopted a new policy on e-cigarettes that specifically declined to recommend the use of e-cigarettes as cessation devices.[82]

6.0 Regulation and policy tools

Since the first Surgeon General's report in 1964, advocates and lawmakers have worked to formulate robust public policy in the US to reduce the harms associated with combustible cigarettes – including passing smoke-free laws, levying taxes, and enacting restrictions on age of purchase and advertising. These measures are widely credited for the dramatic decline in tobacco use and related disease, disability and death.[83] While many of the health risks associated with e-cigarettes are still being studied, a variety of jurisdictions are adopting proactive policies based on the precautionary principle, which suggests that protective action should be taken in the face of risk, even if causation has not been fully demonstrated.[84]

A number of entities have reviewed the available evidence to make policy recommendations, including the American Heart Association and the World Health Organization (see Table 2), as well as a group of 129 public health and medical experts who wrote a letter to WHO Director General Margaret Chan.[85]

Table 3: Recommendations by advocacy organizations

Organization	Recommendations
American Heart Association[78]	• E-cigarettes should be subject to all laws applying to conventional cigarettes, including smoke-free air laws, marketing restrictions, and taxation. • Federal and state governments should ban the sale of e-cigarettes to minors. • There is insufficient evidence to determine whether e-cigarettes are an effective smoking cessation aid, but use as a cessation strategy is reasonable for those for whom NRT and other approved treatments are not an option.
American Public Health Association[82]	• States and localities should ban sale of e-cigarettes to minors, prohibit use in all indoor public areas and workplaces, and enact a tax on nicotine liquid.

World Health Organization[86]	• Manufacturers should be prohibited from claiming that e-cigarettes are an effective cessation treatment option until they receive regulatory approval to do so. • E-cigarette use should be prohibited in public places. • Governments should restrict e-cigarette advertising, promotion, and sponsorship, and regulate marketing content. • Governments should regulate e-cigarette design and disclosure. • Sale to minors should be prohibited.
Washington State Association of Local Public Health Officials (WSALPHO)[87]	• Sale to minors should be restricted by an age of purchase and requiring tobacco retail licensure. • There is insufficient evidence to determine whether e-cigarettes are an effective smoking cessation aid. • E-cigarette manufacturers should be required to label products with ingredients and instructions for use.

6.1 Federal regulation

The Family Smoking Prevention and Tobacco Control Act (FSPTCA), signed into law in 2009, grants the United States Food and Drug Administration (FDA) regulatory authority over the manufacture, distribution, and marketing of tobacco products.[88] The exact definition of "tobacco product" reads,

> "…Any product made or derived from tobacco that is intended for human consumption, including any component, part, or accessory of a tobacco product (except for raw materials other than tobacco used in manufacturing a component, part or accessory of a tobacco product)."[89]

The FDA thus governs both the manufacturing and marketing of tobacco. While nicotine occurs naturally in tobacco and the law recognizes nicotine as an addictive drug, the FSPTCA law only specifies cigarettes, cigarette tobacco, roll-your-own tobacco and smokeless tobacco (limited to "tobacco intended to be placed in the oral or nasal cavity") as subject to regulation.[89, 90] Since e-cigarettes entered the market only two years before the FSPTCA law was enacted, public awareness of the new product was low,[91] and policymakers likely didn't anticipate the need for regulation.[92]

Citing its authority under the Federal Food, Drug, and Cosmetic Act (FDCA) to regulate drugs, in 2014 the FDA announced its intention to regulate e-cigarettes as pharmaceutical drugs (and not as tobacco products). Such regulation would require e-cigarette companies to demonstrate sound manufacturing processes and product safety and efficacy.[93] However, the US Court of Appeals has previously ruled that e-cigarettes could not be considered drugs or drug devices unless marketed for therapeutic purposes, and thus had to be regulated as "tobacco products."[94]

Amid increasing e-cigarette awareness and pressure from the public health community, on April 24, 2014, the FDA issued a proposed rule deeming e-cigarettes (as well as dissolvable tobacco,

tobacco gels, hookah tobacco, cigars, and pipe tobacco) and future nicotine products as tobacco products.[95] Public comment on the proposed rule closed on August 8, 2014 with nearly 82,000 individual comments received, and the rule is not expected to be finalized until late 2015 or 2016.[96] If finalized, the as proposed rule states that e-cigarette manufacturers would be required to:

- Register with the FDA
- Report product and ingredient listings
- Delay marketing of new products and risk claims until FDA has reviewed them
- Stop distributing free samples[97]

Additionally, e-cigarettes and other deemed tobacco products would be subject to minimum age and identification restrictions, health warning requirements, and vending machine sales prohibition.[97, 98]

In the meantime, states and localities have unfettered ability to enact legislation related to e-cigarettes, and have scrambled to catch up. The proposed FDA "deeming rule" does not preempt most lower jurisdictions' regulations that are already in place or those being considered for future adoption. However, in the case of combustible and smokeless tobacco products, many localities across the US are preempted from enacting legislation stricter than equivalent state legislation. Washington State law prevents local jurisdictions from enacting policies that restrict combustible tobacco marketing, smoke-free indoor air and youth access above and beyond state law.[99]

6.2 State and local regulation and policy tools

Fortunately, numerous policy options in the conventional tobacco control realm have already been tested on the state and local levels, and evaluations of their efficacy can serve as a guide to regulating e-cigarettes. As of 2014, 40 states prohibit e-cigarette sales to minors. However, a 2014 analysis by the CDC reports 16 million US children live in the 10 states without laws restricting minor access to e-cigarettes.[100] Fourteen states have restricted e-cigarette use in public places, but only three states have included e-cigarettes in their comprehensive smoke-free air laws. Two states and one city have levied taxes on e-cigarettes, while several have attempted to regulate packaging and marketing of e-cigarettes. Appendix 1 lists states and cities that have enacted policies that regulate e-cigarettes.

6.2.1 Licensing

Tobacco Retailer Licensing laws require businesses that sell tobacco products to buy a license from the government. These licenses provide a way for jurisdictions to identify purveyors of tobacco, and to implement and ensure compliance with state tobacco control program regulations.[101] Perhaps most importantly, local jurisdictions can use licensure laws to restrict the density and location of retail outlets in any given area. Easy access to tobacco retailers is associated with higher rates of teen smoking.[102, 103] Living in close proximity to tobacco retail outlets also has a negative effect on cessation.[104] Because tobacco retailers are clustered in low-income neighborhoods inhabited primarily by people of color, licensure laws provide an

opportunity for local governments to redress disparities in tobacco use and related health outcomes. Licensing requirements can be enacted by state governments (as they are in California) or cities (for example, New York City), and 36 states had licensure laws on the books as of 2014.[105, 106] Some municipalities now require e-cigarette sellers to apply for restricted use permits, such as Buffalo, NY.[107]

The Center for Tobacco Policy & Organizing at the American Lung Association of California defines a strong licensing law as one that [108]:

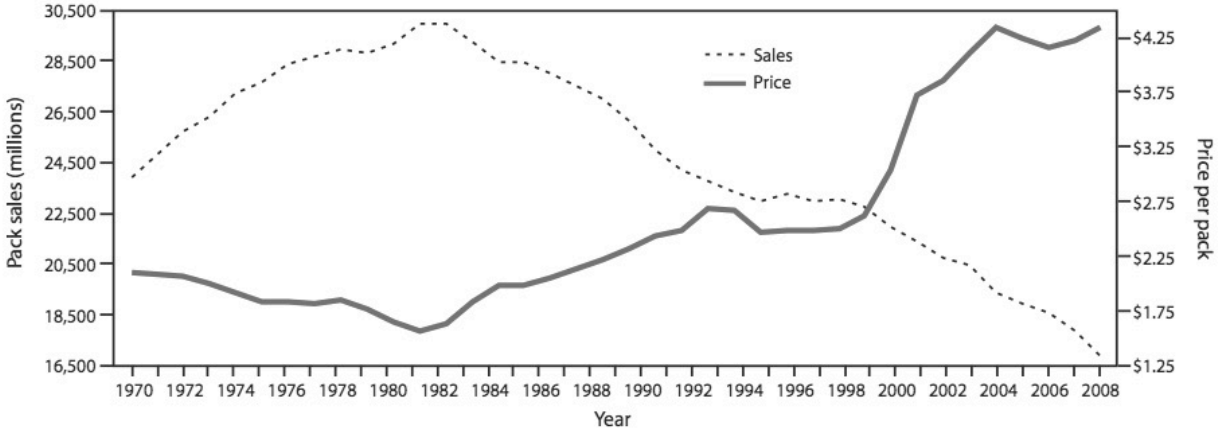
- Requires annual renewal of licensure
- Adequately funds, through fees, enforcement and administration of the licensing program (and perhaps other tobacco control endeavors)
- Recognizes the full landscape of relevant laws by making a violation of any regulation (federal, state or local) subject to penalty or revocation
- Sets fines for violations high enough to act as a deterrent

6.2.2 Taxes

Of all tools available to policymakers for curbing tobacco use, price increases are demonstrably the most effective.[83] Although cigarette addiction might theoretically lead to price inelasticity, cigarette taxation has proven to be the most effective means for reducing cigarette consumption. Studies have demonstrated an inverse relationship between taxation and tobacco use (see Figure 7). As the price of tobacco increases, fewer people smoke (some quit, and some never initiate). This is true across the US population as well as within subpopulations (i.e., youth, people of color and low-income smokers).[109] Results from price elasticity studies show that every 10 percent increase in the real price of cigarettes reduces overall cigarette consumption by approximately three to five percent, the number of young adult smokers falls by 3.5 percent, and the number of kids who smoke declines by six or seven percent.[110]

Tobacco excise taxes are traditionally considered regressive in that low-income tobacco users pay a larger share of their income in taxes than higher-income individuals, who are also less likely to smoke.[111] However, the ultimate *effect* of tobacco taxation is progressive; because their use declines with price increases and because they disproportionately smoke more, and thus experience greater health benefits than wealthier groups.[112, 113] Between 1990 and 2009, federal tobacco taxes rose from 16 cents to $1 per pack, while state taxes increased their own taxes on cigarettes by a factor of four. In part because of these increased taxes, the price of cigarettes increased an average of 125 percent in the U.S. between 1990 and 2009 (see Figure 7).

Figure 7: Cigarette sales and price per pack, 1970-2008



SOURCE: Chaloupka FJ. The economics of tobacco taxation. Chicago, IL: ImpacTEEN, University of Illinois at Chicago; 2009. Available at http://www.impacteen.org/generalarea_PDFs/Chaloupka_TobaccoTaxes_AK_041609.pdf.
* Adjusted to February 2009 dollars.

Source: CDC, 2010.

In drafting a new tobacco tax inclusive of e-cigarettes, policymakers will need to consider the following questions[114, 115]:

- Given the many component parts of e-cigarettes, what should be taxed (e.g., devices, e-liquids)?
- Should the tax be higher, lower or the same as other tobacco products? What are the considerations in light of current evidence on e-cigarettes usefulness as a smoking cessation aid? (Some have argued for a significant cost differential, with conventional tobacco products taxed more heavily, to encourage the purchase of e-cigarettes.)
- Should tax revenue be earmarked for tobacco control, prevention and/or cessation? If so, how can revenue be safeguarded for these purposes?

Two states, Minnesota and North Carolina, have adopted a tax on e-cigarette products. In May 2014, North Carolina adopted an excise tax equal to five cents per milliliter of nicotine liquid (about the same amount of nicotine as in a pack of cigarettes).[116] In Minnesota, a tax equal to 95 percent of the wholesale cost (the same tax as for regular cigarettes) went into effect on July 1, 2014.[117]

6.2.3 Age of purchase restrictions

Children and young adults under the age of 26 are most vulnerable to tobacco addiction. In fact, 99 percent of adults who smoke started before 26; brain development largely prevents adults who initiate use past this age from becoming addicted.[118] For this reason, policies that increase the legal age of purchase of tobacco products to 21 have gained support from prevention advocates. In 1984, Congress raised the age of alcohol purchase to 21, resulting in a sharp decline in drunk driving, alcohol consumption and motor vehicle accidents (and fatalities) among young adults.[119] Youth smoking decreased by half in the first locality (Needham, MA) to enact "Tobacco 21" within five years of its implementation, a significantly greater decrease than in surrounding communities.[119]

As of September 2014, at least 40 states have prohibited e-cigarette sales to minors.[120] Washington State joined this group in 2013, specifically using the term "vapor product" to describe e-cigarettes (at least five states—Colorado, Rhode Island, South Dakota, Tennessee, and Wyoming— added e-cigarettes to their definition of tobacco products[120]).[121] Idaho is also in this majority, further restricting electronic cigarette sales through vending machines accessible to minors[122], as have several other states. These policies are possible because federal government has not passed a law hampering the ability of states and localities to enact legislation (this is known as *preemption*).

In Washington State, King, Pierce, Grant, and Clark counties ban the sale of e-cigarettes to minors under age 18.[123, 124, 125, 126] Similarly, in May 2014, the City of Pasco revised its municipal code to include e-cigarettes in its citywide smoking regulations.[127] These include a ban on sales to minors (including sales through vending machines accessible to minors), penalties for minors who attempt to purchase e-cigarettes, and clear signage about these regulations.[128] Several cities in Spokane County have prohibited sales to minors.[129]

6.2.4 School-based policies and programs

Middle and high school-based tobacco prevention programs include a range of interventions, but generally focus on imparting skills and knowledge via educational curricula. School districts have been among the first jurisdictions to respond to the advent and popularity of e-cigarettes. As of July 2014, 11 of the 18 King County school districts have enacted e-cigarette bans on their campuses.[130] Evidence is mixed as to whether educational programs are effective in preventing long-term initiation or increasing cessation, and a thorough search was unable to locate a single study of 100 percent smoke- and tobacco-free policies in elementary, middle and high schools.[131] At the college and university level, a number of studies have documented the positive effects of smoke-free campus policies on prevalence of use,[132] littering,[133] and overall policy compliance.[134]

6.2.5 Labeling and disclosure

The size and nature of tobacco product warning labels is associated with consumer understanding of the risks of use, with more detailed and graphic labels related to greater knowledge of health harms.[135] Tobacco users are exposed to these messages as many as 7,000 times each year, making labeling an essential tool to promote prevention and cessation.[136] While graphic warning labels (see Figure 8) are now required in 77 countries/jurisdictions worldwide, the FDA's proposed more substantive warning labels in 2012 were ruled unconstitutional in federal appellate court on grounds that they violated the First Amendment.[137] Meanwhile, several studies have found e-cigarette labeling to be inadequate or inaccurate.[55, 57]

Figure 8: Mock-ups of three of the nine graphic warning labels originally proposed by the FDA

Source: US Food & Drug Administration. Available at: http://www.cnn.com/2013/03/19/health/fda-graphic-tobacco-warnings/

The Oregon Department of Justice (OR DOJ) has settled three lawsuits with an e-cigarette manufacturer and brought suit against another on the grounds that, without scientific evidence, marketing claims made by these companies were misleading and fraudulent. OR DOJ is the only state agency in the United States to pursue such legal action.[138]

6.2.6 Flavored products

Tobacco industry documents reveal manufacturers have intentionally configured flavors of their products to appeal to young people.[139] Flavored tobacco products are primarily aimed at and used by youth. One study found 20 percent of smokers aged 17 to 19 used flavored tobacco, compared with 6 percent of older adults.[140] As part of the 2009 FSPTCA law, the FDA banned flavored tobacco products (with the exception of cigars and products with menthol flavoring) and required tobacco companies to discontinue the use of misleading marketing terms like "light" and "low tar" to describe cigarettes.[89]

E-cigarettes are available in more than 7,000 of flavors, with 250 new flavors coming out each month.[141] While only municipality in the United States currently regulates flavored e-cigarettes (Chicago), a New York City councilman recently introduced a bill that would restrict the sale of flavored e-cigarettes to tobacco bars.[142]

6.2.7 Child-resistant packaging

Packaging of potentially harmful consumer products became subject to government regulation in 1970, when Congress passed the Poison Prevention Packaging Act. Child-safety packaging requirements for oral prescription medications are credited with the prevention of hundreds of child deaths from the mid-seventies onward.[143]

In an effort to protect people—children in particular—from liquid nicotine poisoning as described in section 4.0 of this paper, legislators in the US House and Senate introduced a bill in 2014 requiring the Consumer Product Safety Commission to "promulgate a rule to require child safety packaging for liquid nicotine containers…" The bills have moved out of committee.[144]

So far, three states—Minnesota, New York, and Vermont—have enacted a requirement for e-cigarette-related nicotine liquid containers to be sold in "child-resistant" packaging.[145]

6.2.8 Internet sales

Congress passed the Prevent All Cigarette Trafficking Act (PACT Act) in 2010 to address tax evasion in online cigarette sales and prevent Internet sales to youth. Prior to the PACT Act, an estimated 20 percent of online cigarette sellers did not have any age-related purchase requirements, and among those that did, most allowed age to be self-reported.[146] Online e-cigarette sales are booming; Google defines "e-cigarettes" as a "breakout search term," or a phrase that has exploded in use to the magnitude of more than 5000 percent.[147] As of 2009, Washington State prohibits the sale of many tobacco products online directly to consumers. However, e-cigarettes are not included in the definition of "tobacco product" under this law.[148]

The lack of age verification mechanisms used in online purchasing of e-cigarettes and other tobacco products has led some lawmakers to take action. In January 2014, a California lawmaker introduced AB 1500 to regulate online sales, but was ultimately unsuccessful.[149] On August 8, 2014, attorneys general from 29 states (including Bob Ferguson of Washington) submitted a comment to the FDA in response to the "deeming rule" proposal in an attempt to sway the agency toward prohibiting all "non-face-to-face" tobacco sales—including sale of e-cigarettes. The comment argues that since the PACT Act addresses only non-face-to-face sales of cigarettes and smokeless tobacco, the FDA needs to use its regulatory authority, as outlined in the FSPTCA law, to effectively extend this ban to e-cigarettes and all other "tobacco products."[150] Although no state or local government has successfully curbed online e-cigarette sales, private online retailers like Amazon.com have instituted policies that prohibit product listings of this sort.[151]

6.2.9 Marketing and point-of-sale interventions

With current bans on tobacco advertisements on television and in youth-focused magazines, the tobacco industry has sought new avenues to promote cigarettes and other tobacco products, especially to vulnerable youth. Between 1999 and 2008, tobacco companies spent 92 percent of their marketing dollars in gas stations, corner stores and other small retail venues. Young people frequent convenience stores, and thus have high exposure to this form of tobacco advertising.[152] This type of marketing is known as "point-of-sale" (POS), and includes not only the location and type of advertising, but also discounts (i.e., two for one), coupons and other incentives. A 2009 review of the evidence found there was sufficient proof that these types of promotions disproportionately influence youth smoking.[153] A number of policy options are available to regulate POS marketing tactics:

- Licensing (see section 6.2.1 policies to control the community saturation of POS promotions at retail outlets
- Restrictions on coupons and discounts
- Health warnings at or near the cash register at retail outlets
- Restricting product placement so that tobacco products are hidden from view

Many of the very same marketing strategies used for conventional tobacco products are now being deployed to promote e-cigarette brands,[154] an increasing number of which are owned by tobacco companies.[155]

With regard to conventional tobacco, a number of localities have restricted point-of-sale marketing. Providence, Rhode Island, prohibits coupons and other discounts on cigarettes. Three jurisdictions (New York City, Philadelphia and Jefferson County, AL) have passed laws requiring tobacco retailers to post health warnings and/or information on cessation, though these have been subject to tobacco industry lawsuits.[156] As of January 15, 2011, King County Board of Health Code 19.12 prohibits sampling, offering of free or nominal cost electronic smoking devices or liquid nicotine. Martin Luther King Jr. County has the first Board of Health in Washington State to adopt comprehensive regulation of e-cigarettes that includes sampling restrictions, age of purchase restrictions and use in public restrictions.

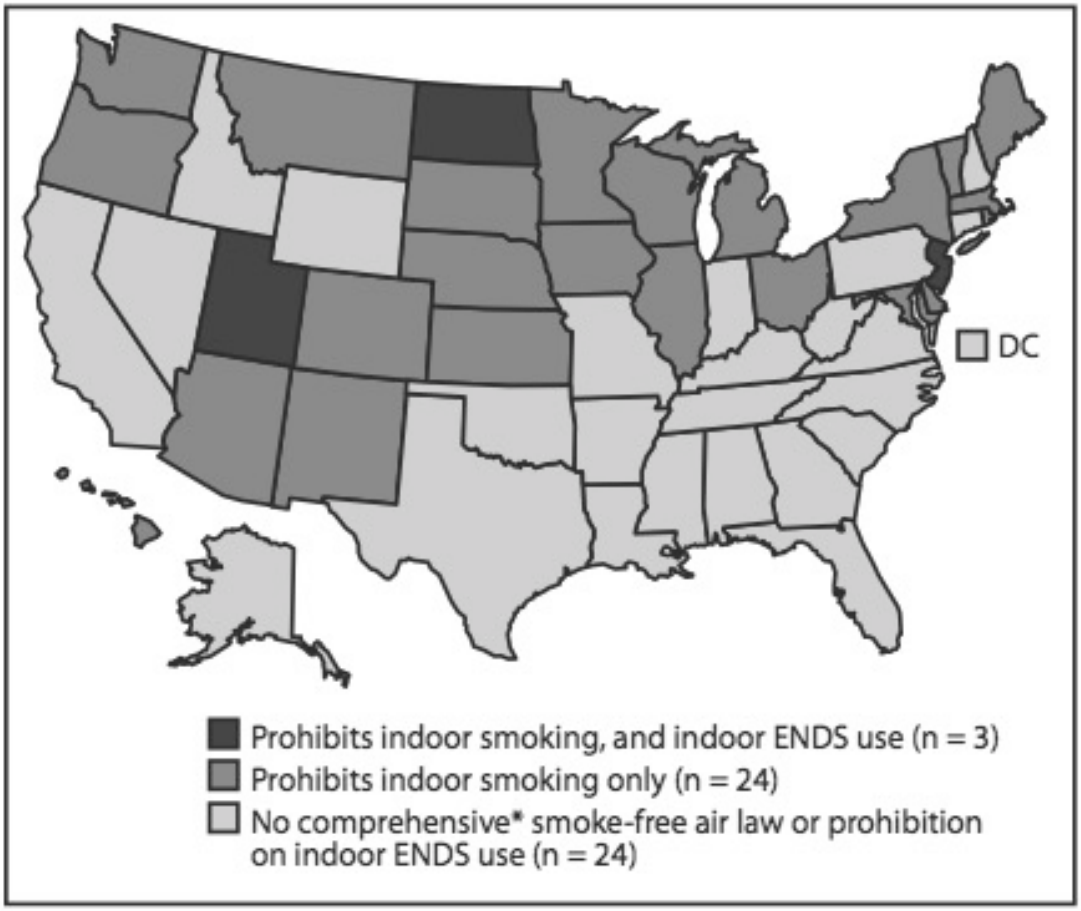
6.2.10 Restricting e-cigarette use

As of October 2014, at least 22,527 US municipalities restrict smoking in public and certain private spaces (i.e., restaurants, bars, indoors).[156] A large body of research documents the benefits of such legislation in, among other things, reducing smoking, asthma prevalence and heart attacks.[157, 158, 159] Jurisdictions may seek to expand smoking prohibitions to e-cigarettes for the following reasons, beyond potential health risks for e-cigarette users outlined in Section 4.0:

- Permitting e-cigarette use may make it more difficult to enforce existing smoke-free rules, as many e-cigarettes look identical to conventional cigarettes
- Allowing use of e-cigarettes could inspire smokers of combustibles to use products in areas where smoking is banned
- If e-cigarette use is permitted in public places, people may be involuntarily exposed to possibly harmful second-hand emissions
- Young people, who are particularly susceptible to tobacco industry marketing, may perceive cigarette use is “normal” and less harmful due to the presence of e-cigarettes in their communities[160]

As of October 1, 2014, three states (New Jersey, North Dakota, and Utah) restricted e-cigarette use in all smoke-free venues within their state indoor air laws, and at least 11 other states prohibit use in some smoke-free public venues—often state-owned property, educational facilities and/or correctional facilities. More than 300 counties and cities restrict use of e-cigarettes in all or some smoke-free areas. Beginning January 1, 2015, Minnesota banned e-cigarette sales from all “moveable places of business” (e.g., kiosks and other transportable structures).[120]

Figure 4: States with and without laws prohibiting smoking and use of e-cigarettes in private worksites, restaurants, bars, 2014



Source: CDC, 2014.

Since January 2011, King County bans e-cigarette use in workplaces, restaurants, and bars.[129] Pierce County prohibits e-cigarettes from "any public place where children are lawfully permitted with the exception of certain places of employment."[125] Grant County adopted equivalent measures that take effect on January 1, 2015.[129] The city of Pasco, Washington, prohibits e-cigarette use in many outdoor public spaces, such as playgrounds and pools, as well as a ban on use in workplaces, restaurants, and bars. The municipal code of Burien, Washington prohibits e-cigarette use in public parks.[161]

7.0 Health effects of e-cigarette policy options

Section 6 of this paper details evidence related to e-cigarette policy changes, included in a proposed bill drafted by Governor Inslee and Representative Pollet. We adapted the Washington State Board of Health "Health Impact Review" guidelines to synthesize the research findings related to tobacco and e-cigarette regulation. We assume for the purposes of this paper that many tobacco-related findings (i.e., the efficacy of tobacco taxes in reducing

smoking prevalence) are generalizable to e-cigarettes. We created a grade-based scale with which to clearly communicate strength of evidence (see Tables 4 and 5 below).

Table 4: Scoring system

A	B	C	D
At least 10 well-designed studies support the association	At least five well- or appropriately-designed studies support the association	At least two studies support the association	Evidence is mixed, with more studies showing a negative association

Table 5: Health impact of e-cigarette policy options

Policy option	Strength of evidence
Tobacco Retail Licensure	**Score: B** *Several small studies support the efficacy of licensure laws in reducing smoking prevalence and improving health outcomes.*
Tax	**Score: A** *Numerous large, well-designed studies support the efficacy of taxation in reducing smoking prevalence and improving health outcomes.*
Age of purchase	**Score: A** *Significant evidence demonstrates that preventing youth initiation will result in a reduced smoking prevalence and improved health outcomes.*
Labeling and disclosure	**Score: B** *A number of well-designed studies demonstrate that tobacco product labeling is positively associated with consumer knowledge of health effects.*
Flavored products	**Score: A** *A number of well-designed studies show that flavored products appeal to youth, who are vulnerable to nicotine addiction.*
Child-resistant packaging	**Score: B** *Child-safe packaging requirements for other potentially dangerous products resulted in a decline in child mortality as a result of poisoning*.
Internet sales	**Score: C** *There is insufficient evidence about the efficacy of laws regulating online sales of conventional products. To date, there is little evidence that e-cigarettes are being purchased online by minors.*

School policies	**Score: C** *There is substantial evidence that tobacco use norms are highly influential in youth initiation, but there is no specific evidence demonstrating that primary and secondary school policies result in decreased prevalence.*
Marketing restrictions	**Score: A** *There is abundant evidence of a dose-response relationship between exposure to tobacco marketing and use, including in convenience store settings.*
Cessation	**Score: C** *While there is emerging evidence that e-cigarettes may help reduce the use of more harmful tobacco products, we do not yet know if there are effective in treating tobacco dependence compared to other evidence-based cessation methods.*

8.0 Conclusion

Although the short history of e-cigarettes has created only a brief time frame in which to examine the evidence, the policy work around conventional tobacco products can help inform policymakers' decisions about e-cigarette regulation. Generalization of lessons from conventional tobacco products is warranted by the common use of nicotine to attract and retain large numbers of consumers. While there is little doubt e-cigarettes are safer alternatives to conventional tobacco products, there is still reason to be skeptical about their promise as cessation devices.

When the landmark Family Smoking Prevention Treatment and Control Act was enacted, the FDA gained authority to regulate cigarettes. One of its first acts was to ban the sale of flavored tobacco products (2009). Since then, e-cigarette manufacturers quickly filled the void with numerous e-cigarette flavorings. These flavorings are known to attract youth, who are physiologically susceptible to nicotine addiction. Strong evidence demonstrates that flavor bans, as well as broader marketing and age-of-purchase restrictions, can reduce nicotine and tobacco product use among youth. A tax on e-cigarettes would further deter youth and adults from purchasing these products. The precautionary principle, paired with the devastating history of tobacco, justifies the regulation of e-cigarettes using a range of proven policy measures. After all, legislation can be amended, but loss of human life cannot.

Appendix 1: E-cigarette policies, by jurisdiction

	Tax	Smoke-free air	No sales to minors	Packaging	Point-of-sale
States					
Alabama			×		
Alaska			×		
Arizona			×		
Arkansas		×[1]	×		
California			×		
Los Angeles		×			
Colorado		×[1]	×		
Connecticut		×[2]	×		
Delaware			×		
Florida			×		
Georgia			×		
Hawaii		×	×		
Idaho			×		×[3]
Illinois			×		
Indiana			×		
Iowa			×		
Kansas		×[4]	×		
Kentucky			×		
Louisiana			×		
Maine					
Maryland			×		
Michigan			×		
Minnesota	×			×	
Mississippi			×		
Missouri			×		
Montana					
Nebraska			×		
Nevada			×		
New Hampshire		×[1]	×		
New Jersey		×	×		
New York			×		
New York City	×	×[7]	×[8]		
North Carolina	×		×		
North Dakota		×			
Ohio			×		
Oklahoma		×[4,5]	×		
Oregon[6]		×[2]			
Pennsylvania					
Rhode Island			×		
South Carolina			×		
South Dakota		×[4]			
Tennessee			×		
Texas					
Utah		×[7]	×		
Vermont		×[1]	×	×	
Virginia		×[1]	×		
Washington			×		
King County		×	×		
Clark County			×		
Grant County		×	×		
Pierce County		×	×		
Pasco (City)		×[9]			
West Virginia			×		
Wisconsin			×		
Wyoming			×		

1. Prohibits use on school property
2. Prohibits use in state workplaces
3. Vending machines
4. Prohibits use on state Department of Corrections property
5. Prohibits use within 300 feet of schools
6. OR Department of Justice ruling prohibits e-cigarette companies from making unsubstantiated claims
7. Permits use in retail establishments that sell e-cigarettes
8. Minimum age of purchase is 21
9. Prohibits use within 25 feet of some outdoor public areas

Sources: National Conference of State Legislatures. Alternative Nicotine Products | Electronic Cigarettes. 2014. Available at: http://www.ncsl.org/research/health/alternative-nicotine-products-e-cigarettes.aspx. Accessed November 4, 2014. Americans Nonsmokers' Rights Foundation. US State and Local Laws Regulating Use of Electronic Cigarettes. 2014. Available at: http://www.no-smoke.org/pdf/ecigslaws.pdf. Accessed November 4, 2011

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