Clearing the Air: E-Cigarettes as a Strategy of Tobacco Harm Reduction

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The recent and rapid expansion of e-cigarettes in the tobacco marketplace has engendered significant controversies in the public health community and beyond, with worries about the effect on vulnerable populations, especially adolescents, and the as-yet-unknown, long-term health risks. In this paper, I will analyze the ethical arguments supporting and opposing the strategy of e-cigarette availability (ECA) as part of tobacco harm reduction (THR). I will consider ECA as a THR strategy to include (1) permitting the manufacture, sale, and use of e-cigarettes, and (2) informing the public of the relative risks of e-cigarettes and combustible cigarettes. I will evaluate the strategy of ECA from a public health perspective, which includes determining whether ECA adequately advances (1) a prevention orientation, including addressing the root causes of disease, rather than treating symptoms of disease after it has occurred; (2) a population perspective, by focusing on overall community well-being, rather than the well-being of individuals alone; and (3) a commitment to social justice, by redressing systematic disadvantage for marginalized groups, rather than assuming all groups within a population are on equal footing (Gostin & Wiley 2016, p. 12-18).

I will argue that supporting ECA as a THR strategy is justified because it (1) is consistent with the primary goals of public health, (2) promotes autonomy, (3) advances social justice, and (4) promotes more overall benefit than harm, in comparison to opposing use of ECA as a THR strategy. Furthermore, I will argue that employing ECA as a THR strategy is supported by utilitarian analysis. Rather than merely contending that there is "no safe tobacco product," it is

better for the field of public health to clear the air and educate the public on the relative risks of combustible and e-cigarettes, thereby enabling people to make more informed choices.

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1.0 Topic

Within the last fifty years, the field of public health has begun to embrace harm reduction programs, which seek to minimize the negative consequences of unhealthy behavior rather than completely eliminating the behavior itself (Single 1995; Erickson 1995). Harm reduction programs are often controversial because critics are concerned that they condone risky behavior, such as drug usage, rather than having prevention of risky behaviors as the sole goal, as with abstinence-focused programs. I will focus on tobacco harm reduction (THR), which encourages smokers to use alternative products or strategies with fewer health hazards than combustible tobacco smoking, which may nevertheless involve the continued ingestion of nicotine (Cox & Dawkins 2018).

The concept of THR can be traced back to 1974, when British psychologist Michael Russell suggested that the goal of complete smoking cessation was "unrealistic and doomed to fail," and instead advocated for gradually changing smoking habits and using less harmful forms of tobacco than cigarettes (1974, p. 254). THR strategies include both (1) non-tobacco interventions that decrease tobacco consumption, and (2) alternative tobacco products (Polosa et al. 2013). In this paper, I will address the use of a particular alternative tobacco product, namely electronic or e-cigarettes, as a THR strategy, because there has been wide disagreement on how to respond to this product's recent and rapid expansion in the tobacco marketplace.

In this paper, I will analyze the ethical arguments in support of and against the strategy of e-cigarette availability (ECA) as part of THR. I will consider ECA as a THR strategy to include (1) permitting the manufacture, sale, and use of e-cigarettes, as well as (2) informing the public of the relative risks of e-cigarettes and combustible cigarettes. Critics of ECA as a THR strategy advocate (1) prohibiting the manufacture, sale, and use of e-cigarettes, and (2) withholding

information from the public about the relative risks of e-cigarettes and combustible cigarettes. For example, critics have concluded that e-cigarettes "should be removed from the market and permitted back only if and when it has been demonstrated that they are safe" (Cobb et al. 2010, p. 2341-2342). Generally, the primary public health message is that "there is no safe tobacco product," rather than providing information about the differential risks of tobacco products (Czoli et al. 2017, p. e49; see also Kozlowski & Edwards 2005). Instead of providing information about the relative risks of e-cigarettes compared to combustible cigarettes, critics advocate for placing warning labels on e-cigarettes that emphasize the health risks of nicotine (Trtchounian & Talbot 2011).

THR is a public health strategy, and accordingly, I will evaluate the strategy of ECA from a public health perspective, which includes determining whether ECA adequately advances (1) a prevention orientation, by averting the root causes of disease, rather than treating symptoms of disease after it has occurred; (2) a population perspective, by focusing on overall community well-being, rather than the well-being of individuals alone; and (3) a commitment to social justice, by redressing systematic disadvantage for marginalized groups, rather than assuming all groups within a population are on equal footing (Gostin & Wiley 2016, 12-18). Furthermore, I will analyze ECA using the autonomy principle of bioethics to determine whether these principles are better supported by adopting or abandoning ECA as a THR strategy. Finally, I will examine ECA using a utilitarian perspective to determine whether the strategy maximizes potential benefits and minimizes harm in comparison to preventing access to e-cigarettes.

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2.0 Background

Tobacco smoking is a global public health threat, and kills more than 8 million people a year (WHO 2019). In the United States alone, cigarette smoking accounts for about 1 in 5 deaths, and is the leading cause of preventable death and disease (CDC 2019). Though smoking cessation has clear and immediate benefits, smokers who attempt to quit overwhelmingly fail to do so, with only about 3-5% achieving long-term (6-12 month) abstinence (Hughes et al. 2004). Furthermore, smoking cessation medications that are currently available as part of THR—such as nicotine replacement therapy (including patches, gum, etc.) and certain antidepressants—only modestly increase the rate of smoking cessation in trial settings, with only about 10-15% of smokers achieving long-term abstinence (Casella et al. 2010). Even more problematic, these results have not been replicated outside these trials in "real-life situations" (Casella et al. 2010, p. 99). In addition, many smokers have no desire to quit the habit. Thus, to minimize the harm that smokers cause to themselves and others through secondhand smoke, some public health officials have advocated for ECA as a THR strategy, which gives smokers the option to use e-cigarettes rather than combustible cigarettes and informs smokers of their relative risks, in order to reduce the harms people are exposed to from smoking.

E-cigarettes heat up a solution, usually composed of propylene glycol or glycerin, nicotine, and flavoring agents, to deliver the nicotine to the smoker in an aerosol or vapor (McNeill et al. 2015). A review of the aerosol from 12 brands of e-cigarettes found that the levels of toxins present in aerosol were 1 to 2 orders of magnitude lower than in combustible cigarette smoke (Grana et al. 2014). Thus, e-cigarettes are able to deliver nicotine to users effectively, but with significantly fewer toxins than combustible cigarette smoke. In addition, e-cigarettes replicate the experience

of smoking traditional cigarettes more closely than other alternative tobacco products, both behaviorally, with the repetitive hand-to-mouth motion, and visually, with the smoke-like vapor (Polosa et al. 2013). In this way, e-cigarettes are an appealing, less-risky alternative to combustible cigarettes for many smokers.

However, e-cigarettes are not completely risk-free; for example, low levels of toxins, such as formaldehyde, have been found in e-cigarette aerosol, particularly in flavored varieties (Grana et al. 2014). Furthermore, nicotine is still an addictive substance, and exposure to it *in utero* can have "lasting adverse consequences" on brain development (U.S. Department of Health and Human Services. 2014, p. 6). Thus, ECA as a THR strategy remains controversial, and the public health community has not yet reached a consensus on how best to manage the manufacture, sale, and use of e-cigarettes, or whether and how to provide information about their relative risks compared to combustible cigarettes.

3.0 Aims, Outline, and Anticipated Conclusion of the Argument

In this paper, I will not challenge the factual foundation of tobacco harm reduction (THR) strategies, but rather will consider the ethical considerations that arise in implementing ECA as a THR strategy, in terms of (1) permitting the manufacture, sale, and use of e-cigarettes, and (2) informing the public of the relative risks of e-cigarettes and combustible cigarettes. Accordingly, I will stipulate a set of widely-accepted facts documented by health authorities in the U.S. (NASEM) and U.K. (PHE)—namely, that smokers who switch completely to e-cigarettes can materially reduce their risk of death and disease (PHE estimates by 95%); that use of e-cigarettes is nevertheless associated with some harm; that use of e-cigarettes is associated with potential for nicotine addiction; and that a small proportion of youth who would otherwise not smoke and who adopt e-cigarettes may be caused to subsequently take up smoking.

Critics of ECA as a THR strategy are concerned about the following: using ECA as a THR strategy (1) will create a new generation of smokers who would not have adopted the habit otherwise, and the potential harms to this group outweigh any harm reduction for current smokers from a utilitarian perspective; (2) will cause the public to misunderstand the risks associated with e-cigarette usage, inducing more people to continue and take up e-cigarette smoking; (3) will only increase harm, conflicting with healthcare professionals' and the field of public health's duty to reduce harm, because (a) there are safer FDA-approved, pharmaceutical nicotine products to stop smoking, and (b) using ECA as a THR strategy would merely allow smokers to continue their nicotine addiction when they would have quit otherwise; and (4) will ignore the social-ecological model of public health, which emphasizes how the social, physical, and cultural aspects of people's environments affects their behavior, and ultimately, their health (Stokols 1992). Despite these

objections, I will argue that supporting ECA as a THR strategy is justified because it (1) is consistent with the primary goals of public health, (2) promotes autonomy, (3) advances social justice, and (4) promotes more overall benefit than harm than opposing ECA as a THR strategy would. Furthermore, I will argue that (1) permitting the manufacture, sale, and use of e-cigarettes, and (2) informing the public of the relative risks of e-cigarettes and combustible cigarettes are supported by utilitarian analysis.

4.0 Characterizing 'Harm' in the Context of the E-Cigarette Debate

The harm from smoking combustible cigarettes consists in the following health risks:

1. Increased risk of cancers, especially lung cancer;
2. Increased risk of coronary heart disease;
3. Increased risk of chronic obstructive pulmonary disease (COPD) and other lung diseases, including emphysema and chronic bronchitis;
4. Increased risk of stroke;
5. Increased risk for diabetes, asthma, rheumatoid arthritis, and other chronic diseases;
6. Decreased fertility for both men and women;
7. Increased health risks for babies before and after birth;
8. Decreased immune function (CDC 2018a).

Moreover, the harm from smoking goes beyond biological consequences, and causes harm through increased healthcare utilization and cost, as well as increased absenteeism from work (CDC 2018a). Some may consider that the addictive property of nicotine is harmful because they consider addiction itself, apart from the health effects of nicotine, to be harmful (Benowitz 2008); however, consideration of whether addiction is harmful and, if so, the nature of that harm, is beyond the scope of this paper. Thus, I will not consider addiction as a harm caused by smoking, either combustible or e-cigarettes.

In comparison to combustible cigarettes, e-cigarettes have fewer and less serious health risks. Nevertheless, they do present some risk of harm, which resides in the following:

1. Glycol and propylene glycol are known upper airway irritants (Callahan-Lyon 2014; Grana et al. 2014);
2. Increased heart rate and blood pressure, observed in non-smokers after smoking e-cigarettes (Cooke et al. 2015);
3. Increased respiratory flow resistance, similar to cigarette use (Vardavas et al. 2012);
4. Impaired fetal development when exposed to nicotine *in utero* (England et al. 2015);
5. Altered brain development in adolescents (England et al. 2015; Goriounova & Mansvelder 2012).

5.0 Evidence of Harm and the Viability of ECA as a THR Strategy

Critics of ECA as a THR strategy will likely point out that there is not yet conclusive evidence on the health risks of e-cigarettes. However, a good way to navigate this uncertain terrain is to compare the state of evidence regarding the health risks of e-cigarettes to the current body of evidence regarding the health risks of combustible cigarettes. In contrast to the lack of certainty regarding the safety of e-cigarettes, there are "unambiguous certainties" regarding the significant health risks of combustible tobacco products (Drummond 2015, p. 1). Combustible cigarettes have been well-studied for decades, and therefore we have accumulated a large body of evidence, which has demonstrated repeatedly the significant health risks of these products. Indeed, the report of the U.S. Surgeon General has concluded that cigarette smoking is "*causally* linked to diseases of nearly all organs of the body" (U.S. Department of Health and Human Services. 2014, p. 7, emphasis added). Furthermore, there is a strong dose-response relationship linking heavy smoking, longer durations of smoking, and early uptake of smoking with higher risks of smoking-related diseases and mortality (Edwards 2004), and tobacco is the main known cause of cancer-related mortality (Sasco et al. 2004). This is not surprising, considering that combustible cigarettes contain at least 70 recognized carcinogens (Drummond 2015).

The health risks regarding e-cigarettes are not yet well characterized; however, the current state of evidence suggests that e-cigarettes cause significantly less harm to smokers than combustible cigarettes, with risks comparable to conventional nicotine replacement products (Cahn & Siegel 2011). For example, e-cigarette vapor contains 9- to 450-fold lower levels of harmful compounds, such as formaldehyde and heavy metals, than combustible cigarette smoke, and e-cigarettes have fewer acute adverse effects on the cardiovascular system than combustible

cigarettes (Drummond 2015). Moreover, the vapor from e-cigarettes causes significantly less harm to non-smokers than secondhand smoke from combustible cigarettes (Czogala et al. 2013). Few youth use e-cigarettes as a "gateway drug" to combustible cigarettes (Drope et al 2017); the overwhelming majority of people who use e-cigarettes are former cigarette smokers, and many of them use e-cigarettes as a smoking cessation technique (King et al. 2015; Vardavas et al. 2015; Schoenborn & Gindi 2015). Finally, nicotine has few significant health risks for adults (Moore et al. 2009) and has not been causally linked with cancer (Murray et al. 2009).

Even the CDC states that e-cigarettes are less harmful than regular cigarettes, though it concludes, "that doesn't mean e-cigarettes are safe" (CDC 2018b). However, because we know without a doubt that combustible cigarettes cause significant harm, and we have sufficient reason to believe that e-cigarettes cause significantly less harm than combustible cigarettes, we are justified in pursuing ECA as a THR strategy while we continue to compile evidence on the effects of e-cigarettes. Only if sufficient evidence to the contrary emerges should e-cigarettes be abandoned as a viable THR strategy, since the alternative for the 36 million Americans who have been unable to quit smoking would be certain harm from cigarette smoke (Drummond 2015).

Furthermore, one likely reason for the lack of conclusive evidence regarding e-cigarettes is that the devices have a wide variety of design types, and there are many different brands of e-cigarettes, all dispensing liquids that have widely varying ingredients and nicotine concentrations, and flavors that have varying compositions (Breland et al. 2016). Thus, this variability in device type and ingredient composition likely explains the variability observed across studies, especially since some flavors have been found to contain harmful ingredients that are not present in other flavors. If e-cigarettes were to become regulated by the federal government, then this variability could be reduced, which would enable researchers to better evaluate the health risks of e-cigarettes.

In addition, safety regulations could be established to prevent product contamination and ensure accuracy in labeling.

If some combination of the following conditions were to obtain and increase overall harm, then this would provide a reason for reconsideration of ECA as a THR strategy, because the public health justification for employing as a THR strategy would be undermined:

1. If sufficient evidence were found that e-cigarettes caused as much harm to smokers as combustible cigarettes;
2. If sufficient evidence were found that the vapor from e-cigarettes caused as much harm to non-smokers as secondhand smoke from combustible cigarettes;
3. If large numbers of youth who took up e-cigarette smoking switched to using combustible cigarettes, and overall, more youth took up e-cigarettes and eventually combustible cigarettes than would have in the absence of e-cigarettes, an issue explored further in section 3.1;
4. If large numbers of people who took up e-cigarette smoking switched to using combustible cigarettes, and overall, more people took up e-cigarettes and eventually combustible cigarettes than would have in the absence of e-cigarettes; or
5. If nicotine were found to have significant negative health consequences.

Weighing the net harms and benefits of the obtaining of any combination of these conditions would be essential to the calculation of determining whether ECA ultimately results in a greater net harm than in the absence of the strategy. However, since such evidence has not yet

materialized, the burden of proof lies with opponents of ECA as a THR strategy to demonstrate that the strategy results in a greater net harm for the population.

6.0 Utilitarian Analysis of an ECA Strategy of THR and Related Issues

6.1 E-Cigarettes as a "Gateway Drug" and Utilitarian Arguments

Critics of ECA argue that e-cigarettes act as a "gateway drug" to cigarettes. In other words, critics suggest that if young people become addicted to nicotine while using e-cigarettes, then they are more likely to take up the extremely harmful habit of smoking combustible cigarettes throughout their lifetimes. In this way, the availability of e-cigarettes would create a new generation of combustible-cigarette smokers who would not have adopted the habit otherwise; because of this, critics argue, the potential harms from this group outweigh any harm reduction for current smokers from a utilitarian perspective.

According to critics, even if ECA reduced the harm all current smokers are exposed to from cigarette smoking, because this new generation of smokers would face significant harms that they would not have otherwise endured because they had access to e-cigarettes, an ECA strategy would increase total harm. In other words, critics argue that if e-cigarettes were available, then the reduction of harm for current smokers who switch to e-cigarettes would not be enough to outweigh the significant harm faced by this new generation of potential smokers, who would never have taken up smoking if e-cigarettes had never been made available to them. Therefore, critics suggest, it would be better to support smoking cessation interventions alone, because not only would this strategy reduce total harm for all smokers, it also would not expose a new generation of potential smokers to nicotine and tobacco smoking, and thereby would minimize harm for the overall population.

Furthermore, opponents argue, the field of public health should adopt a prevention orientation, and allowing access to e-cigarettes conflicts with this goal, because it fails to prevent a new generation from being exposed to the harmful effects of tobacco. Critics also suggest that ECA as a THR strategy conflicts with the field of public health's goal of harm reduction, as failing to restrict access to e-cigarettes fails to prevent harm to this potential group of potential future smokers.

While critics might argue that ECA is ruled out from a utilitarian perspective, because the harm caused to youth smokers by allowing access to e-cigarettes would outweigh any benefits for adult smokers, more analysis of this claim is needed. First of all, there is not yet conclusive evidence that significant numbers of young people who have never previously smoked are using e-cigarettes and eventually switching to combustible cigarettes. For example, while some longitudinal studies have found an association between e-cigarette and combustible cigarette usage, there is not yet sufficient evidence to conclude that this relationship is causal (Drope et al. 2017). One reason for this association might be a "reverse gateway," as youth who smoke combustible cigarettes are also more likely to have used e-cigarettes (Drope et al 2017, p. 463). Indeed, e-cigarette usage is significantly higher in current smokers compared to former and never-smokers, with only about 1% of never-smokers having ever used an e-cigarette (King et al. 2013; Vardavas et al. 2015).

Moreover, even if it is assumed that there is a small proportion of youth who have access to and take up combustible cigarettes after using e-cigarettes, utilitarian analysis still supports an ECA strategy. First, assume that harms from e-cigarette smoking are significantly less than combustible cigarette smoking. With adoption of a strategy that banned e-cigarettes, both adult and youth smokers would suffer significant harm, because their only option would be to smoke

combustible cigarettes. However, with the adoption of a strategy that permits the manufacture, sale, and use of e-cigarettes, a significant number of adult cigarette smokers would switch to this method of nicotine consumption, and therefore, as a group, would suffer significantly less harm.

Second, even if youth gain access to e-cigarettes, data on youth smoking trends suggest that the number of youth combustible cigarette smokers would decrease almost to 0, as the majority of young adults who use tobacco have switched from combustible cigarettes to e-cigarettes, with overall tobacco usage remaining constant (Arrazola et al. 2015). Indeed, e-cigarette use by youth is "virtually nonexistent" unless they are already smokers (Farsalinos & Polosa 2014, p. 80), and current cigarette use is the strongest predictor of e-cigarette use in adolescents (Camenga et al. 2014). Thus, youth who choose to smoke will overwhelmingly choose to use e-cigarettes if an ECA strategy is in place. Importantly, this group would be roughly the same size as the number of youth smokers under a strategy which bans access to e-cigarettes, since there is not sufficient evidence to suggest that the number of youth smokers overall is increasing. Because of this overwhelming switch to e-cigarettes, youth smokers would suffer significantly less harm under an ECA strategy.

Finally, I will consider the potential for a group of youth smokers who critics argue would take up e-cigarettes and later switch to combustible cigarettes. As previously discussed, if youth have access to e-cigarettes, then virtually all youth smokers will switch to this option rather than continuing to use combustible cigarettes (Arrazola et al. 2015; Camenga et al. 2013). Yet even if it assumed that there is a small number of youth e-cigarette smokers who later take up combustible cigarettes, utilitarian analysis still supports an ECA strategy. This small group of youths might indeed suffer more harm than if they had never had access to e-cigarettes. However, because there would be significant reductions in harm for the much larger population of adult smokers who

switch to e-cigarettes, then the total harm caused by employing ECA as a THR strategy would still be reduced, even though there might be a small number of youth who incur greater harm to themselves. While this assumes that a sufficient number of smokers will switch to e-cigarettes, this outcome is quite likely based on current trends of e-cigarette usage (King et al. 2015; Vardavas et al. 2015).

In this way, ECA is supported by utilitarian analysis, because adopting ECA as a THR strategy would cause significantly less harm to the population as a whole. Indeed, this conclusion is supported by many models which assess the relative health benefits and costs of e-cigarettes, in terms of life-years saved or lost due to both adult smoking cessation and e-cigarette-induced smoking initiation (Levy et al. 2017). For example, in one model's "worst-case assumptions," the U.S. population would gain over 580,000 life-years if ECA strategies are supported (Warner & Mendez 2019, p. 41).

Thus, it seems that the only way critics can claim that use of ECA as a THR strategy should be ruled out from a utilitarian perspective is if e-cigarette smoking is considered to be just as harmful as combustible cigarette smoking. However, as noted previously, e-cigarette smoking is significantly less harmful than combustible cigarette smoking (McNeill et al. 2015).

6.2 Concerns About Nicotine and Addiction

Still, critics might respond that youth who take up e-cigarette smoking become addicted to nicotine, and such an addiction will produce just as much harm in the long run as combustible cigarette smoking. It is true that nicotine exposure at a young age—particularly *in utero*, but potentially through adolescence, when the prefrontal cortex is still maturing—can have significant

detrimental effects on brain development (Goriounova & Mansvelder 2012). However, it is important to note that nicotine itself is not particularly harmful for adults, and even has some benefits such as improved concentration and working memory (Swan & Lessov-Schlaggar 2007). Advocating for adults' access to e-cigarettes as a THR strategy does not entail arguing for unlimited, universal access to e-cigarettes. On the contrary, the arguments made herein support restrictions against allowing adolescents to purchase or otherwise have access to e-cigarettes, and are consistent with advising pregnant women to avoid all forms of nicotine, including e-cigarettes, entirely. It is argued that if adults have access to e-cigarettes, though they may still be addicted to nicotine, this addiction has significantly fewer adverse consequences than smoking combustible cigarettes.

Also, even if there would be a small proportion of youth who gain access to e-cigarettes despite restrictions and become addicted to nicotine, and even if this group could potentially suffer from cognitive impairments in the future, there would still be significantly less overall harm, because the overwhelming majority of the smoking population could incur fewer harms to themselves by switching to e-cigarette smoking. Again, while this presumes that an adequate number of smokers will switch to e-cigarettes, this outcome is very likely based on current trends of e-cigarette usage (King et al. 2015; Vardavas et al. 2015). In other words, from a utilitarian perspective, even if this small group experiences a greater degree of harm, the population as a whole would still be better off in virtue of suffering less harm if adults have access to e-cigarettes. Furthermore, health-related harm from an addiction to nicotine would still be significantly less than the considerable and certain harms caused by combustible cigarette smoking.

6.3 Youth as Warranting Special Protections

Critics might object that society has a special duty to protect youth from the harms of smoking. This special duty might be grounded in youth's particular vulnerability to the harms of smoking, because youth are more susceptible to forming a nicotine addiction, or because nicotine addiction in young adults may affect the development of their brains, and therefore have life-long effects (Goriounova & Mansvelder 2012). This special duty might also be grounded in youth's lack of decisional capacity, in terms of lacking information about and appreciating the risks of smoking (Slovic 2000; Romer & Jamieson 2001). Thus, critics argue, this potential new generation of smokers deserves stronger consideration than adults who smoke. If this were so, then the utilitarian analysis described above would fail, because the new generation of smokers would have more weight, and the harm from any individual youth smoker would count more. Therefore, critics argue, the increased harm youth would endure from taking up combustible cigarette smoking would tip the scales against ECA as a THR strategy, even though the youth population of smokers would still be smaller than the adult population.

However, a special duty to protect youth from harm can still be recognized without rejecting the utilitarian calculus described above, a calculus which is capable of supporting a measure that would prevent significant harm to adult smokers if they switch to e-cigarettes. For example, tight restrictions that prevent youth from gaining access to e-cigarettes could be imposed, with strong penalties for those who sell e-cigarettes to minors. In addition, an excise tax could be imposed to further prevent youth from accessing e-cigarettes by making them more costly; this strategy has proven to be effective in preventing youth from accessing combustible cigarettes, with increases in tobacco excise taxes reducing the initiation and uptake of tobacco among youth (Chaloupka et al. 2010).

6.4 ECA, Non-Smokers, and Social Justice

Additionally, an ECA strategy, which (1) permits the manufacture, sale, and use of e-cigarettes, and (2) informs the public of the relative risks of e-cigarettes and combustible cigarettes, will reduce harms from secondhand smoke for the non-smoking population. Secondhand smoke from combustible cigarettes exposes non-smokers to high concentrations of toxic and carcinogenic compounds, causing more than 600,000 deaths every year worldwide (Czogala et al. 2014). However, while vapor from e-cigarettes still emits significant amounts of nicotine, it does not emit significant amounts of carbon monoxide or volatile organic compounds (VOCs). Importantly, e-cigarettes release significantly lower levels of nicotine than tobacco cigarettes (Czogala et al. 2014). Because of this, ECA strategies result in less harm to the population overall than strategies that restrict access to e-cigarettes.

In turn, this analysis demonstrates that ECA does not in fact conflict with the field of public health's duty to reduce harm, because overall, the strategies that allow access to e-cigarettes prevent more harm than they incur—as long as a sufficient number of smokers switch to e-cigarettes, an outcome which is quite likely based on current trends of e-cigarette usage (King et al. 2015; Vardavas et al. 2015). Furthermore, ECA is compatible with public programs that emphasize smoking prevention for the general population, especially youth. Indeed, there are different levels of prevention of public health interventions that can operate simultaneously to improve the overall health of the population. Interventions aimed at stopping behaviors from occurring in the first place are at the primary level of prevention; interventions aimed at precluding harm from exposure to known risk factors are at the secondary level of prevention; and interventions aimed at reducing, instead of reversing, harm are at the tertiary level of prevention (Walker & Shin 2002). Thus, permitting access to and use of e-cigarettes in addition to traditional

education programs merely adds a different level of prevention, expanding from a primary level of prevention alone, to adding a tertiary level of prevention, which aims to reduce the harms from combustible cigarette smoking by providing smokers the option to switch to e-cigarette smoking.

6.5 ECA, Social Justice, and Health Disparities

Finally, ECA is justified from a social justice perspective because a greater proportion of people who are smokers belong to disadvantaged populations. Indeed, while the population of the United States has experienced an overall decline in cigarette smoking, disparities in smoking persist, with smoking more prevalent in racial and ethnic minority groups, especially American Indians, Alaskan Natives, and the LGBT community, as well as those of low socioeconomic status or with a history of mental health conditions (Garrett et al. 2011). The promotion of social justice is a fundamental ethical principle in the field of public health (Gostin & Wiley 2016; Gostin & Wiley 2018) and supports redressing systemic disadvantage. Social and economic factors are likely to have increased the likelihood of members of these disadvantaged groups beginning to smoke; thus, concern to redress systemic disadvantage supports helping to reduce the harm caused by tobacco use. Preventing access to e-cigarettes would prevent these groups from achieving this reduced level of harm.

One factor that complicates ECA as a THR strategy within disadvantaged populations is that there is a significant cost barrier to switching from smoking combustible cigarettes to e-cigarettes. Specifically, there is a higher up-front cost, because users must pay for the device in addition to the e-liquid refills. Because of this initial up-front cost for the device, current prices of e-cigarettes are generally much higher than combustible cigarettes, even if they cost less per

comparable unit (Liber et al. 2017). However, this issue of the relatively higher price of the less harmful alternative could be remedied either by raising the taxes on combustible cigarettes, or by lowering the taxes on e-cigarette devices and refills, so that e-cigarettes are more affordable, or both. In this way, there would not be a financial barrier to switching to the less harmful alternative; rather, there would be a financial incentive to switch to e-cigarettes.

Critics might object to using tax policies to make e-cigarettes more affordable or relatively less expensive than combustible cigarettes, since excise taxation most often affects disadvantaged groups, who smoke at a higher rate, and for whom these taxes make up a larger proportion of their income (Gostin & Wiley 2016). Yet there are ways to remedy these effects; for example, perhaps the devices could be provided to certain disadvantaged populations, either at a reduced cost or for free in some cases, just as there are clean needle distribution programs to help drug users minimize their exposure to bloodborne diseases. Furthermore, if the cost of e-cigarettes is reduced below the current cost of combustible cigarettes, then low-income smokers would still receive a financial benefit from switching to e-cigarettes, in addition to a health benefit, even if they must still pay some excise taxes. Indeed, changes in cigarette prices have been shown to have the greatest impact on reducing the smoking rate in disadvantaged populations, which are also least responsive to health education measures (Townsend et al. 1994). Thus, increasing the price of cigarettes relative to e-cigarettes helps to reduce the disparities in smoking-related health risks between socioeconomic groups, thereby promoting social justice.

7.0 Public Misunderstanding of Risks Associated with E-Cigarette Usage

Opponents of ECA argue that having information about the lower risks of e-cigarettes would result in a public misunderstanding of risks, causing more people to continue and take up e-cigarette smoking. Indeed, when "light," or low-tar, cigarettes were introduced, smokers misinterpreted them to be a safer and less addictive product (Etter et al. 2003). However, smokers were actually exposed to greater health risks when smoking "light" cigarettes, because they smoked them more frequently and intensely (Cahn & Siegel 2011). In the same way, critics argue, any advertisements or promotion of e-cigarettes created by their manufacturers would likely present information in a way that minimizes the risks, rather than providing an accurate portrayal of the associated dangers, leading consumers to think that they could smoke e-cigarettes without any significant health risks. Furthermore, critics of ECA suggest that a public health campaign that promotes e-cigarettes as a safer option than combustible cigarettes would also mislead consumers into underestimating the risks associated with e-cigarette usage. Opponents of ECA argue that, therefore, information about the relative safety of e-cigarettes compared to combustible cigarettes should be strictly regulated, in order to promote the field of public health's goal of prevention at the population level.

In response, it must be noted that although prevention of morbidity and mortality is an important public health goal, this goal must be carefully balanced with individual rights and freedom, and the least restrictive alternative necessary to achieve a prevention goal should be adopted by public health officials (Gostin & Wiley, 2016). In this case, the federal government could regulate advertisements for e-cigarettes in the same way that they regulate those for combustible cigarettes, and require sufficient warning labels as well as accurate portrayals of

information to mitigate the likelihood of misunderstanding. This regulation of advertising and requirement of accurate portrayals of risks and potential benefits of e-cigarettes would be a less restrictive alternative to banning their use or the advertising of them. While people are susceptible to logical fallacies and errors in reasoning, they should nevertheless have access to accurate information about the relative risks of combustible cigarettes and e-cigarettes.

It is important to recognize that even though people may remain susceptible to reasoning errors, there are ways of presenting or framing the information that make its misinterpretation less likely. For example, when numerical information about the risk of a surgical procedure was supplemented with visual aids, framing effects were either reduced or eliminated in study participants with low numeracy skills (Garcia-Retamero & Galesic 2010). Furthermore, without any access to information about the relative risks, people are unable to make an autonomous choice about their options. In this way, providing information and choice respects individual persons and their rights.

One might suggest that instead of providing information to consumers that could be misinterpreted, it would be preferable to instead tax cigarettes and e-cigarettes according to their relative risk. In this way, the use of harmful products is likely to decrease. Indeed, some have argued that because e-cigarettes have a low risk of harm, they either should not be taxed at all, or at least taxed at a lower level than tobacco cigarettes (Bullen et al. 2016). While this is a valid course of action from a public health perspective, coupled with restricting information, it would still fail to respect autonomy, because people are unable to make an informed choice that reflects their values.

Furthermore, public health entities, such as the FDA and CDC, should be known for being transparent sources of accurate information about health risks. If public health agencies like the

CDC were to restrict information about the relative risks of e-cigarettes compared to combustible cigarettes, then this would likely erode the public's trust in these public entities. Indeed, the effectiveness of public health institutions depends heavily on the public's trust (Gostin & Wiley 2018, 51; Kozlowski & Edwards 2005). Thus, practicing transparency, by not concealing information about e-cigarettes, will build the public's trust in public health agencies and will improve the likelihood that these agencies' educational campaigns and interventions will produce the desired result, namely reducing the health risks adults are exposed to by smoking combustible cigarettes. Indeed, without any "evidence-based health-risk communication" from public health institutions, the public's reliance on industry-sponsored marketing, the media, and anecdotal evidence is likely to increase (Czoli et al. 2017, p. e55). Furthermore, if the public discovers that public health agencies have failed to provide accurate information about health risks in the case of e-cigarettes, then the public will likely question or disregard future risk communications from these agencies (Kozlowski & Edwards 2005). Thus, public health institutions should educate the public regarding the relative risks of combustible and e-cigarettes.

8.0 Risks of Harms of E-Cigarettes Compared to Nicotine Replacement Therapy

Critics of ECA also argue that the availability of e-cigarettes will, on balance, increase harm, thereby conflicting with the field of public health's goal of harm reduction, because (a) there are safer FDA-approved, pharmaceutical nicotine products to stop smoking through nicotine replacement therapy, and (b) the use of ECA as a THR strategy would merely allow smokers to continue their nicotine addiction when they would have quit otherwise, and thus should not be used as a THR strategy. Furthermore, they may argue that the population perspective of public health would suggest that public health interventions should aim to lower the overall risk the population is exposed to from tobacco, which would be achieved by helping as many people as possible to quit smoking, in any form, since any usage of tobacco products presents a health risk.

While there are some alternative nicotine products used in nicotine replacement therapy that have a lower risk than e-cigarettes, this argument ignores that these products fail to help most people quit smoking (Casella et al. 2010). In addition, e-cigarettes are a more appealing alternative to most smokers because they replicate both the behavior (hand-to-mouth motion) and the visual cues (vapor) of combustible cigarette smoking (Polosa et al. 2013). Indeed, e-cigarettes have been shown to help smokers reduce the number of combustible cigarettes they smoke, or even quit smoking entirely (Caponnetto et al. 2013; Bullen et al. 2013; Brown et al. 2014). In this way, e-cigarettes can significantly reduce the health risks smokers are exposed to, since smokers who relapse after attempting to quit with pharmaceutical nicotine would face a higher degree of health risks from continuing to smoke combustible cigarettes. For example, smokers who switched to using e-cigarettes were exposed to substantially lower levels of carcinogens and toxicants (Goniewicz et al. 2017), and asthmatic smokers who switched to e-cigarettes had significantly

improved lung function (Polosa et al. 2016). Even though, ideally, all smokers would be able to quit using pharmaceutical nicotine products, e-cigarettes are a more realistic way of preventing harm from smoking. Furthermore, while smokers who switch to e-cigarettes may continue to be addicted to nicotine, the harms associated with nicotine itself are minimal (Moore et al. 2009; Murray et al. 2009); and because most smokers who attempt to quit using pharmaceutical nicotine products are unsuccessful, the harms from continuing to smoke e-cigarettes and ingest nicotine are significantly less than the harms associated with smoking combustible cigarettes. Because of this, there is insufficient evidence to reject the case for ECA as a THR strategy.

Critics might protest that because there is some known harm associated with e-cigarettes, there is a public health duty to seek to eliminate all risk/harm. In other words, merely *reducing* known risk/harm is unacceptable; instead, it is imperative to work to completely remove the risk/harm, and therefore public health interventions should aim to help smokers completely quit both tobacco and e-cigarettes. However, public health endeavors do not operate in the laboratory, but in the real world, and must therefore take a practical perspective. Accordingly, it is extremely unlikely that any public health prevention campaign, no matter how effective, would be able to reduce smoking to 0% of the population, at least in the foreseeable future, since people have continued to smoke cigarettes for decades despite knowing about the health risks. In other words, many people seek the pleasure of smoking and are unlikely to completely abandon the habit, so it is better to take a more practical perspective, and work to reduce the harm incurred by those who choose to smoke, by adopting an ECA strategy, which (1) permits the manufacture, sale, and use of e-cigarettes, and (2) informs the public of the relative risks of e-cigarettes and combustible cigarettes.

In addition, individual rights and autonomy should not be completely overridden in pursuit of the public health goal of prevention. Rather, public health officials should choose the least restrictive option necessary to reach a prevention goal (Gostin & Wiley, 2016). In this case, public health officials could provide information about the relative risks and benefits of both pharmaceutical nicotine products and e-cigarettes, and allow adults to access both of these products. Enabling adults to choose between nicotine replacement therapy and e-cigarettes as a THR strategy would be a less restrictive alternative than preventing access to e-cigarettes altogether, by prohibiting their manufacture, sale, and use.

Furthermore, critics who advocate for prohibiting the manufacture, sale, and use of e-cigarettes as a THR strategy would limit autonomy, because people would be prevented from choosing among various THR strategies, including not only nicotine replacement therapy but also ECA, and deciding which course of action aligns best with their values. Indeed, many people who smoke have no desire to quit, perhaps because they find the behavior pleasurable or because nicotine provides some benefits (Swan & Lessov-Schlaggar 2007), but they might also have no desire to quit because they have not been offered a safer yet similar alternative. However, if people were given the option to smoke e-cigarettes, which are similar to combustible cigarettes in terms of both behavior and enjoyment, then they might be more likely to make the autonomous choice to take up this less harmful way of ingesting nicotine. In this way, an ECA strategy supports the autonomy of smokers, by allowing them to choose among a range of options to reduce their smoking, and select the option that best supports their individual values and desires.

Of course, just because smokers should be able to act in accordance with their values, this does not mean that they have an unlimited right to smoke cigarettes, whether combustible or e-cigarettes, wherever they want. In other words, merely recognizing smokers' rights to autonomy

does not mean that they should have unlimited autonomy. Rather, there should be reasonable restrictions on where smoking is allowed in public places—and indeed many such restrictions are already enacted across the United States—so as to minimize harm to others, and prevent smokers from infringing on others' rights to autonomy.

9.0 Failure to Employ the Social-Ecological Model of Public Health

Critics may also argue that ECA as a THR strategy is not sufficient because it ignores the social-ecological model of public health, which emphasizes how the social, physical, and cultural aspects of people's environments affects their behavior, and ultimately, their health (Stokols 1992). This model of public health also emphasizes the "dynamic interplay between situational and personal factors" that affects a person's health, rather than focusing on environmental or behavioral determinants of health alone (Stokols 1996, p. 283). In other words, people do not make choices about how to behave in a vacuum; rather, their behaviors are influenced and reinforced by their environment, which can either promote or be detrimental to their health.

Indeed, many environmental factors, including the social, physical and economic context of an individual's life, influence the likelihood of smoking behavior. For example, an individual might be more likely to smoke if she is from a community with a high prevalence of tobacco use, and she might be exposed to more advertising of tobacco products if she is from a low-income family and is exposed to more television (Gostin & Wiley 2016). Furthermore, those of a lower socioeconomic status and those with lower levels of educational attainment are more likely to smoke (Garrett et al. 2011)

Thus, critics suggest, ECA as a THR strategy addresses only the symptoms, and not the root cause of why many people take up smoking; the strategy merely aims to minimize harm, rather than prevent harm altogether. Indeed, prevention of ill health is a primary goal of public health, and ECA as a THR strategy fails to intervene at the level of primary prevention, or stopping smoking behavior from occurring in the first place, according to opponents. Furthermore, because smokers comprise a higher proportion of disadvantaged populations, including racial and ethnic

groups and those of low socioeconomic status, and ECA fails to intervene to prevent smoking in these groups, critics argue that the strategy conflicts with the public health goal of social justice. In other words, critics argue, ECA as a THR strategy does not meet the needs of disadvantaged populations that are at-risk for smoking, and only meets the needs of people who are already smoking, and is therefore an insufficient public health policy.

Though ECA as a THR strategy does not intervene at the social and environmental level to prevent smoking, such interventions are not inconsistent with ECA. On the contrary, an intervention that focuses on social, physical, and/or economic factors of peoples' environments would work well in concert with an ECA strategy to reduce the overall harms experienced by smokers and the general population. For example, interventions to prevent smoking that influence the physical and social environment, such as limiting where people can smoke and community health education programs about the relative risks of combustible and e-cigarettes, could be enacted while also allowing adults to access e-cigarettes.

These strategies would then work together simultaneously to reduce the harm that people experience from smoking and to prevent smoking in the first place. In this example, by limiting where people can smoke, harm to others is minimized, and by allowing adults to access e-cigarettes, harm to smokers themselves is reduced; by creating community health programs, people can be informed of the risks if they choose to smoke, and learn how they can reduce that risk by choosing e-cigarettes over combustible cigarettes. Thus, the overall harm the community experiences due to smoking would be reduced, preventing some persons who have not yet started smoking from being exposed to its harms, and helping to reduce the harm that smokers experience.

While primary prevention would be the ultimate public health goal with regard to tobacco use, so that there is no need for harm-reduction strategies, in the meantime, reducing as much harm

from tobacco as possible is a worthwhile goal, and ECA contributes to this goal. Furthermore, disadvantaged populations have the most to gain from ECA, since they are most likely to be at risk of the harms from smoking. If ECA was abandoned, and the manufacture, sale, and use of e-cigarettes was prohibited, and instead primary prevention interventions that target the social or economic level were adopted, disadvantaged populations would likely not receive many, if any, benefits. This is because it would be too late for adults who have already started smoking to benefit from any primary prevention interventions, which are designed to prevent smoking in the first place.

Indeed, those of low socioeconomic status are less likely to have access to health care and by extension, access to FDA-approved, prescription nicotine products (Hiscock et al. 2012). Thus, employing ECA as a THR strategy, by (1) permitting the manufacture, sale, and use of e-cigarettes, and (2) informing the public of the relative risks of e-cigarettes and combustible cigarettes, will more easily allow these populations to significantly reduce the harms they incur on themselves by smoking, since ECA as a THR strategy prevents the significant hurdle of needing access to a medical professional in order to obtain safer forms of nicotine.

10.0 E-Cigarettes and Broader Public Health Harm Reduction Measures

I have presented arguments in support of two harm reduction measures: (1) permitting the manufacture, sale, and use of e-cigarettes, and (2) informing the public of the relative risks of e-cigarettes and combustible cigarettes. In this section, I will consider additional public health harm reduction measures.

10.1 Should the Use of E-Cigarettes Be Promoted by Public Health Agencies?

In stark contrast to the United States, in the U.K., the primary health agency, Public Health England (PHE), actively promotes e-cigarettes as part of "an explicit smoking harm-reduction campaign that [prioritizes] reducing health risks over achieving total abstinence from nicotine" (Fairchild et al. 2019, p. e2). Should the United States follow U.K.'s lead, and actively encourage combustible cigarette smokers to switch to e-cigarettes?

Since the current state of evidence suggests that e-cigarettes are significantly less harmful than combustible cigarettes, public health agencies in the United States should also promote e-cigarettes as a THR strategy. Since very few people have accurate perceptions of the relative risk of combustible and e-cigarettes (Czoli et al. 2017), I suggest that a main focus of public health campaigns should be on educating the public about these relative risks by providing accurate, easily understandable information. Then, consumers will be able to make an educated and autonomous choice, rather than acting on incomplete information or false beliefs about the relative risks of combustible and e-cigarettes. Indeed, studies suggest that accurate perceptions of the risks

of smoking are more likely to result in smoking cessation (Borrelli et al. 2010; McCoy et al. 1991). Since the body of evidence regarding the risk of e-cigarettes is not yet complete, the risks and limitations of ECA as a THR strategy should also be stated. For example, a public health campaign could acknowledge that e-cigarettes are not a completely safe product since the long-term risks of using e-cigarettes are not yet known, but also explain that the current evidence suggests e-cigarettes are significantly less harmful than combustible cigarettes. Indeed, because there is conclusive evidence that combustible cigarettes cause significant harm, and there is sufficient evidence that e-cigarettes cause significantly less harm than combustible cigarettes, public health agencies have a duty to promote e-cigarettes as a THR strategy.

10.2 Should the Use of E-Cigarettes Be Promoted by Clinicians?

The ideal goal for clinicians would be for their patients to stop smoking entirely. Therefore, clinicians might begin by encouraging their patients to quit using tobacco in any form, and they might suggest that their patients first attempt to quit smoking by using FDA-approved, pharmaceutical nicotine products (Fiore et al. 2014). In other words, it might be appropriate for clinicians to begin by suggesting smoking cessation methods other than e-cigarettes, since using e-cigarettes would not be the ideal or best-case scenario.

However, if these strategies fail or are not considered acceptable by patients, then it would be appropriate for clinicians to suggest that their patients switch to using e-cigarettes, either to reduce their consumption of combustible cigarettes or to help them quit smoking entirely. While clinicians should aim for the ideal goal of eliminating tobacco use among their patients, for patients who have failed to quit smoking using pharmaceutical nicotine products, or are currently unwilling

to quit smoking, it would be appropriate for clinicians to join public health efforts to promote the use of e-cigarettes as a way of reducing harm from smoking.

10.3 E-Cigarettes and Governmental Regulation

Currently, while people have access to e-cigarettes in the United States, the products are not yet fully regulated by the FDA, though some regulation is slated to take effect in 2022 (FDA 2019). To improve the safety of these products, and to protect minors from accessing them, there are various governmental interventions that should be considered, similar to those already applied to combustible cigarettes.

First, to minimize the potential for non-smokers beginning to use e-cigarettes, the advertisement of e-cigarettes might be regulated to the same degree as combustible cigarettes, and special care taken to ensure that advertisements are not targeted specifically towards adolescents. Furthermore, relative-risk comparisons between e-cigarettes and combustible cigarettes might be permitted for use in e-cigarette advertisements, as long as they have been evaluated by the FDA for inaccurate representations of harms, to help ensure that consumers accurately understand the associated risks.

Second, one of the potential harms of the currently unregulated market of e-cigarettes is that the products have not been tested for safety and for accuracy in labeling. To minimize potential harms, the FDA might require companies to disclose all ingredients in e-cigarettes, and set limits for potentially harmful components. Likewise, the FDA might establish standards for nicotine yields, in order to prevent tobacco companies from increasing nicotine levels over time (Zeller & Hatsukami 2009).

Third, to minimize the potential for harm to bystanders, clean air policies (smoke-free zones) might be expanded to include e-cigarettes in addition to combustible cigarettes. Doing so might also minimize the potential risk that the prevalence of e-cigarette smoking could re-normalize smoking behavior, as well as the potential risk of exposing non-smokers to secondhand vapor. Fourth, to minimize the potential for youth to gain access to e-cigarettes, the online sale of e-cigarettes might be prohibited, and strict penalties for retailers that illegally sell e-cigarettes to minors and for those who purchase e-cigarettes on behalf of minors could be imposed. Finally, to minimize the demand for combustible cigarettes over time, and thereby reduce the harm caused by them, taxes on combustible cigarettes should be increased regularly over time, while e-cigarettes might be taxed at a lower rate than combustible cigarettes. This strategy could encourage a reduction in the consumption of combustible cigarettes over time, as increasing the cost of the more harmful compared to the less harmful products can promote preferences towards the less costly products (Zeller & Hatsukami 2009).

10.4 E-Cigarettes and Environmental Determinants of Health

As noted in section 9.4, public health interventions that incorporate considerations from the social-ecological model in combination with ECA as a THR strategy would help to minimize harms from smoking. Strategies at multiple levels of prevention could be implemented, and multiple groups in the population could be targeted simultaneously. In the following two subsections (10.4.1 and 10.4.2), I provide examples of possible strategies.

10.4.1 E-Cigarettes and the Physical Environment

First, the social-ecological model of public health stresses that the physical environment affects people's behavior and their health, and the physical environment can also influence the social environment. One application of this is barring smokers from using combustible cigarettes in most public spaces. Not only does this prevent non-smokers from being physically exposed to secondhand smoke, it also reinforces social norms that discourage smoking, or de-normalizes the behavior (Gostin & Wiley 2016). This approach could also easily apply if ECA is used as a THR strategy; smokers would still be allowed to purchase and use e-cigarettes, but where they could smoke them would be restricted. In this way, people would be able to reduce the harms they are exposed to from smoking by using a less-risky alternative, namely e-cigarettes, and smoking behavior would still be de-normalized by banning e-cigarette use in public areas. De-normalization of all smoking behavior, whether combustible or e-cigarettes, would act at the primary level of prevention, and would help to discourage adolescents from adopting the habit; and ECA would operate at the tertiary level of prevention, reducing the harms that people are exposed to from smoking.

10.4.2 E-Cigarettes and the Social Environment

Second, the social environment in which people live and interact with other members of their community plays a significant role in influencing both people's behavior and their health; the community and culture in which people live reinforces their actions and discourages deviation from the norm. Thus, interventions that incorporate this essential consideration of the social-ecological model of health should aim to change cultural norms around smoking, thereby reducing

harms to those who currently smoke, and decreasing the likelihood that youth in the community will take up the habit by emulating those around them. For instance, comprehensive community health programs could be introduced, which target multiple prevention levels, including (1) educational programs aimed primarily at youth, to prevent smoking initiation (primary prevention); (2) programs that support enacting "clean air" policies (smoke-free zones) in more places in the community, especially in public places that children frequent, preventing exposure to risk factors (secondary prevention); and (3) smoking cessation programs (tertiary prevention), which combine pharmacotherapy and counseling services to improve the success rate of quitting (Hiscock et al. 2012).

ECA can seamlessly be incorporated into these policies, (1) by further developing educational programs to communicate knowledge about the relative risks of combustible and e-cigarettes; (2) by expanding "clean air" policies to encompass both combustible and e-cigarettes, to minimize non-smokers' exposure to secondhand smoke and vapors, and to de-normalize the behavior; and (3) by offering e-cigarettes as a way to reduce or cease the smoking of combustible cigarettes when other strategies have failed or smokers are reluctant to quit. In low-income areas, community health centers could also provide the device for free, or at a reduced cost, to minimize the initial up-front cost for smokers, and thereby avoid a potential hurdle for low-income smokers to switch to using e-cigarettes. This last point also demonstrates how programs designed to intervene at the social level can interact with the economic environment in communities, further establishing how the different aspects of individuals' environments simultaneously influence their behavior and, ultimately, their health.

11.0 Conclusion

The recent and rapid expansion of e-cigarettes in the tobacco marketplace has engendered significant controversies in the public health community and beyond, with worries about vulnerable populations, especially adolescents, and the as-yet-unknown, long-term health risks. However, the development of this new "disruptive" product in the tobacco industry deserves a measured response by the field of public health, which should balance the potential harms and benefits, and act on what is currently known, rather than being consumed with the unknown.

Indeed, although uncertainties remain about the risks of e-cigarettes, there is conclusive evidence regarding the considerable and certain harms from smoking combustible cigarettes. Therefore, because the current weight of evidence suggests that e-cigarettes are significantly less harmful than combustible cigarettes, public health officials are justified in pursuing ECA as a THR strategy. Furthermore, in this paper, I have argued that supporting ECA, which includes permitting the manufacture, sale, and use of e-cigarettes, and informing the public of the relative risks of e-cigarettes and combustible cigarettes, as a THR strategy is justified because it (1) conforms with the primary goals of public health, (2) supports autonomy, (3) encourages social justice, and (4) promotes more overall benefit than harm than opposing ECA as a THR strategy would.

Where there is concern of e-cigarettes acting as gateway drugs for youth, this can be addressed by regulation and taxation, so that adults can still reduce the harms they are exposed to from smoking by switching to e-cigarettes; where there are worries about the public misunderstanding the risks associated with e-cigarette usage, these can be mitigated by presenting the information in formats that minimize the potential for misinterpretation, such as employing visual aids, and regulating the information that is supplied by e-cigarette manufacturers. Although

there are some pharmaceutical nicotine products with lower risks than e-cigarettes, this must be balanced with the acknowledgement that most smokers who attempt to quit using these products fail, and e-cigarettes have helped smokers reduce their consumption of cigarettes and avoid the considerable and certain harms of smoking combustible cigarettes. Finally, while ECA does not target the root cause of smoking, this strategy can work in concert with other prevention strategies to reduce the harms the overall population experiences from smoking, especially disadvantaged populations. Ultimately, rather than concluding merely that there is "no safe tobacco product" and preventing access to e-cigarettes entirely, it is better for the field of public health to clear the air and educate the public on the relative risks of combustible and e-cigarettes, enabling people to make informed choices about which tobacco products they use, rather than clouding the air with deceptive information.

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