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Teen Attitudes Towards Vaping and Their Relevance to Policy

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Abstract

Teens are increasingly using vapes and e-cigarettes to vaporize nicotine and marijuana resulting in acute problems such as lung failure and long-term health implications that are still largely undiscovered. Vaping became more prevalent than traditional smoking among teens in 2014 and has continued to grow in popularity. A variety of policy tools exist but utilizing them effectively has been a slow process. Identifying the most effective policy levers requires an understanding of the attraction of vaping from the perspective of teens. Specifically, the difference between teen interest in vaping and traditional cigarettes must be understood since education, policy, and advertisements used to discourage teen smoking may not be effective in curbing teen vaping. To maximize success, policy needs to address both external factors that attract teens (such as flavor, design of the vapes, and price point) as well factors that are internal to the vaping experience (such as peer validation, perceived risks and the lack of psychological barriers). A broad policy approach that includes a focus on aspects specific to vaping that are not salient to other risky behaviors, including traditional cigarettes, has the best chance of curbing teen vaping.

Keywords: ***Vaping; Adolescent; Teen; Health.***

1. Introduction

Recently, adolescent vaping became become a major topic in educational [1] and popular media, bringing what was already a significant issue into sharper public focus. Adolescents are using vapes to vaporize nicotine-free liquid, nicotine and illicit substances [2] despite the significant risks, outlined in the first section of this article. Adolescents underestimate the health risks inherent in e-cigarette usage including the risk of addiction [2]. In addition, some long-term health effects of vaping are still unclear or not known [3].

Identifying the most effective policy approach to halting the teen use of e-cigarettes requires an understanding of why teens are drawn to vaping. Examining the aspects of e-cigarettes that are enticing to adolescents and teens will help clarify what areas are being addressed by policy and highlight other areas have not been explored sufficiently. Policy grounded in what is known about why teens are drawn specifically to vaping is most likely to effectively combat the

issue of teen vaping. This article will suggest a broader approach to policy aimed at reversing the upward trend of teen usage.

2. Teen Usage

In the last decade, as teen usage of combustible cigarettes has steadily declined, e-cigarettes have trended in the opposite direction [4]. In 2014 e-cigarettes became the most commonly used tobacco product among middle and high school students in the United States [5]. As e-cigarettes gained popularity in general, they have quickly become broadly used by the adolescent population [6-8]. The most recent 30-day usage results from the Center for Disease Control and Prevention [CDC] for high school students are 11.7% for electronic cigarettes [9] and more than a quarter of high school seniors report having vaped in the past year [10]. Even teens who report not using e-cigarettes respond that they did use when the question was framed about a specific device or brand [11] suggesting that true teen usage may be higher than reported.

3. Nicotine

E-cigarettes that contain nicotine are habit forming [3,12]. E-cigarettes have the potential to deliver a sufficient dose of nicotine to the brain that would induce dependence, similar to cigarettes [12,13]. As such, it is unsurprising that there is substantial evidence that e-cigarette use results in symptoms of dependence [3].

Adolescents are of particular concern, since they are more vulnerable to nicotine dependence [14,15]. Furthermore, nicotine exposure during developmental stages, such as adolescence where the prefrontal cortex and other higher order cognitive functions are developing, can produce changes in brain chemistry and architecture by impairing the development of neurons and brain circuitry [14].

4. Dangers

Despite the absence of tar in e-cigarettes, they have been shown to cause serious health issues including impairing cellular metabolism [12], cardiovascular disease [16] and most recently, lung failure [4]. In addition, some evidence has been found that even vaping non-nicotine liquid can inhibit immune cell function in the lungs, making users more susceptible to infection [17].

In the summer of 2019, more than 200 teens were hospitalized with breathing issues that doctors believe are tied to vaping [18]. This lung failure is known as Vaping-Associated Pulmonary Injury (VAPI) and presents as a chemical burn from an inhaled substance [19]. By the end of September of 2019, the CDC [4] had received reports of at least 530 cases, from 38 states, of lung injury with seven cases of death tied to e-cigarettes and theorized that these cases are tied to unknown chemical exposure. Although the particulars of this respiratory illness are still unclear, it certainly represents “an emerging clinical syndrome or syndromes” (p. 1) and further research is necessary [20].

Especially with VAPI’s emergence, there is insufficient data to conclude that e-cigarettes use will not result in serious health issues over and above those already caused by combustible cigarette use. Although there is insufficient research

to reach a conclusion about the effects of long-term exposure to the low doses of these chemicals found in e-cigarettes [3], this should not be construed as reassurance about the potential risks of vaping. Additionally, the NAM report [3] included studies published through August 2017, so conclusions will need to be re-examined in light of more current research.

In addition, e-cigarette vapor contains vaporized trace metals and other carcinogenic chemicals, even when they are nicotine-free [3]. A current review of literature [21] concludes that vapor from e-cigarettes contains chemicals which can be harmful, sometimes at levels similar to combustible cigarettes. This has ramifications both for individuals who vape and those who are in contact with them. Later studies also found nicotine exposure for those living in a home with e-cigarette users [22] and those in a simulated environment patterned after exposure in a social setting [23].

5. Exposure and Availability

Environmental factors contributing to increased adolescent e-cigarette use include exposure to e-cigarette advertisements [24] and the availability of e-cigarettes for adolescents [25]. E-cigarette advertising that adolescents are exposed to is associated with increased e-cigarette use [26],[27]. In 2014, 18.3 million middle and high school students (68.9%) were exposed to e-cigarette advertisements [28]. Adolescent brain activity (measured with fMRI neuroimaging) illustrates the significant impact of e-cigarette advertising [29]. One study found that teen participants had increased brain activity in areas of the brain associated with cognitive control, reward, visual processing/attention and memory when viewing e-cigarette advertisements, as compared to similar advertisements for other products [29].

Teens believe that they can easily acquire e-cigarettes [24,25,30] and substantial evidence points to the fact that online purchases plays a significant role in this availability. In a 2015 study [31] minors were supervised trying to buy e-cigarettes from almost 100 online vendors using credit cards. More than three quarters of the sales were successful despite state regulations requiring age verification which were being ignored by these companies. Similarly, adolescents report being refused service online at half the rate they experience refusal at brick and mortar shops [32]. The consensus of the research echoes the finding that youth purchasing online was relatively easy with few instances of age-verification [12].

6. Policy History

6.1 Federal policy

The Family Smoking Prevention and Tobacco Control Act was enacted in June of 2009, giving the FDA regulatory power over tobacco. The act includes a ban on sale of tobacco to youth, restricts marketing and requires warning labels and a listing of ingredients on tobacco products [33]. Although e-cigarettes were first imported to the US in 2006 [6], the FDA's regulatory authority was only extended to electronic nicotine delivery systems (ENDS) in 2016. Under the 2016 extension, the FDA is granted regulatory authority over the manufacture, import, packaging, labeling, advertising, promotion, sale, and distribution of ENDS [34]. The regulation also included a significant amount of vaping materials that either do not contain nicotine or are part of the hardware used in vaping non-nicotine products. When this rule went into effect, it became illegal to sell e-cigarettes to anyone under 18 and retail stores were required to ask for identification for purchasers under 27. Producers were also required to submit ingredient lists and include warning

labels. Steps have also been taken to stop the marketing of e-cigarette products in ways similar to youth-market oriented food products [35].

At least five lawsuits were promptly filed against the FDA arguing first amendment violations in the limitations and approval process [36]. The initial planned date for e-cigarettes to be registered with the FDA was 2018. However, in reaction to the outcry, the FDA delayed the deadline till 2022. The response to this delay was further legal action against the FDA, this time from physicians and special interest groups citing concern for adolescents in the intervening time before the oversight of vaping products would go into effect [37]. More research is needed into how this regulatory change has impacted teen usage of e-cigarettes and how the safety of e-cigarettes has been affected.

6.2 State policy

Since 2010 many states have enacted legislation treating e-cigarettes as traditional cigarettes in terms of limiting usage indoors and most states have some sort of indoor ban on vaping [38]. However, as of September 2017, the CDC found that only eight states (as well as DC and Puerto Rico) had fully banned vaping in bars, restaurants and worksites [39].

A CDC survey examined which states had enacted basic regulation around e-cigarettes and found that sixteen states had none of them. The regulations in this list were requiring commercial license to sell e-cigarettes, banning indoor use, establishing 21 as the minimum age for purchase, prohibiting self-serve e-cigarette displays and applying an excise tax to e-cigarettes [39]. As of June 2019, fifteen out of the U.S. states have taxes on e-cigarettes, 29 have regulations relating to product packaging, and all states except for Pennsylvania have an age restrictions on purchasing e-cigarettes [38]. The minimum age for purchase ranges from 18 to 21 with most states setting the minimum at 18 years of age. Only about half of states require a license for retail establishments to sell e-cigarettes [38]. States without sufficient regulation would benefit from research into the effectiveness of these policies in other states that could spur their own policy changes.

7. Teen Interest and Perceptions

7.1 Teen interest

Equally as concerning as current usage data for adolescents, is data on how interested teens are in trying e-cigarettes, as openness to trying e-cigarettes has been shown to be a significant risk factor for future vaping [26]. Teens in large numbers express a willingness to try vaping devices [40]. Over 30% of a group of 3,600 high schoolers in Connecticut who hadn't yet vaped said they would use e-cigarettes in the future despite the fact that only 12% currently identified as users [41]. In a survey of students from middle school through college, curiosity about e-cigarettes was even higher, between 50% and 60% in all three groups [42].

The teen attitudes relating to e-cigarettes cited in the literature can be organized into a two by two array (Table 1). The horizontal axis divides aspects of vaping into perceived positives and negative aspects of combustible cigarettes absent from e-cigarettes. The columns indicate a second distinction between perception of e-cigarette users that are internal as opposed to those that are external – visible attributes of the e-cigarette or the act of vaping. These distinctions will be helpful for organizational purposes and will have ramifications on creating policy.

Table 1: (From Grebenau [43]) – Aspects of Teen Interest.

	External	Internal
Perceived Positives	Flavors Price Point Design	Peer Validation
Absence of Barriers	Ease of Concealment	Perceived Risks Lack of Psychological Barriers

7.2 Flavor

Teen self-reporting and objective data support the fact that flavor is a significant factor in teen e-cigarette usage and a sensible target for policy measures aimed at curbing teen vaping. Despite the dangers, e-cigarettes represent a more enticing option for teens than traditional cigarettes due to the flavors. High school students, as a group, showed a much stronger preference for flavors than either middle school or college students [42]. In national studies, taste and flavors are the second highest reason for vaping, reported by between 30% and 40% of teen users [2,44]. In a more recent literature review, flavors moved to the most significant determinant for adolescents considering experimenting with e-cigarettes [45].

Teens report choosing vaping over cigarettes due to flavoring [5,8] and are more likely to try e-cigarettes when the liquid is flavored [45],[46]. Teens were more than four times as likely to use candy-flavored and five times as likely to use fruit flavored e-cigarettes in contrast with the control (tobacco flavor). Alcohol flavored e-cigarettes had a marginally higher response rate (4%) than the tobacco control (2.2%), indicating that it is not simply the presence of flavor, but these specific types of flavors entice teens. Flavor was related to higher rates of teen usage even when controlled for the difference in risk perception of flavors as opposed to non-flavored e-cigarettes [46]. Thirteen studies were cited in a survey of the literature confirming adolescent interest in flavors, especially fruit or candy flavorings [45]. Adolescents also mention the variety of flavors as a draw to e-cigarette use [30],[40],[47]. Flavored e-cigarettes are perceived to be easier to use by teens than their unflavored counterparts [48] and even advertisements for flavored e-cigarettes caused more interest in vaping among adolescents than similar ads that don't mention flavor [49].

7.3 Price point

Although the prices of e-cigarettes vary significantly, some are marketed as being cheaper than combustible cigarettes. This lower price point of e-cigarettes is appealing to the teen population [5],[8],[30]. In a small longitudinal study in Scotland, at least one of the teens who stopped using e-cigarettes over the six months of the study cited the rising cost of e-cigarettes as the cause [50]. The lower price point was also cited by some older, university aged, e-cigarette users as a reason they started using e-cigarettes [42] as well as by 12% of adults interviewed in vape shops [51].

However, the majority of evidence suggests that price point is not a significant reason for teen vaping. A survey showed that almost half of California teens believed e-cigarettes to be more expensive than combustible cigarettes [52]. Additionally, in the 2016 national tobacco youth survey, price point was cited by only about 3% of respondents as a reason they use e-cigarettes, compared to five times as many respondents citing that e-cigarettes are less harmful than combustible cigarettes and ten times as many respondents citing flavors [53].

Price does seem to have some import to adolescents but may be a secondary concern once teens begin using tobacco, rather than a reason they are attracted to the practice as a non-user. However, even if the lower price point is not a significant draw for teens to vape, a higher price point would discourage use, as McKeganey and Barnard [50] found. In a survey of California 9th and 12th graders, 69.79% and 73.21% respectively, responded that if prices for e-cigarettes were higher teens would be less likely to use them [52], demonstrating the prevalence of this attitude.

7.4 Design

Just as teens enjoy owning the latest phone or popular gadget, teens enjoy the look of the vaping devices themselves and want to own them [40],[42]. The sleek look of JUULs specifically, is mentioned by Hammond, Wackowski, Reid, and O'Connor [54] in their study on JUUL use by young people in the US. Similarly, ease of modification was cited in at least one study as a reason for interest in vapes among adolescents [45]. However, although some teens spoke about the design in a positive way, others commented that it looked foolish to use a vape when compared with smoking combustible cigarette [30].

7.5 Ease of concealment

E-cigarettes generally have their own internal heating element and do not require the use of an outside lighter or heating source [9]. This, along with their compact design, means e-cigarettes are easily hidden. The lower risk of discovery is another reason for teen preference of vaping [8] over traditional cigarettes mentioned by teens [47]. Teens mention the ability to conceal vaping devices as a reason they are able to vape in their homes [47] and at school [8]. The fact that the vapor dissipates quickly along with the lack of residual smell [30] and the resemblance of some devices to USB drives, are additional reasons that vaping can be easily concealed [55]. This low fear of discovery contributes to the trend of adolescent using e-cigarettes as opposed to combustible cigarettes.

7.6 Peer validation

In general, a linkage has been demonstrated between peer usage of illicit substances and adolescent experimentation of these substances, likely due to both peer pressure and peer normalization of the behavior [56]. The social acceptance of smoking among adolescents is influenced by peer usage [57] and the same is true of vaping [58]. In a survey of over 4,000 students, 22.4% felt a reason teen use e-cigarettes was to have a good time with friends [44], recognizing this peer influence. As opposed to combustible cigarettes, where peer influence is strongest in middle school [59], for e-cigarettes the greatest peer influence is present during the transition from middle school to high school [60].

The perception of peers and the ability to do tricks contribute to the peer validation of e-cigarette use. Peer validation [5] and vaping being seen as “cooler” than traditional cigarettes [8], have been suggested as reasons for adolescent

interest in e-cigarettes. Almost 40% of teen's who identified as e-cigarette users agreed that a friend or family member's use of e-cigarettes contributed to their own usage, the most often picked reason for vaping among teens [53]. This parallels findings on combustible cigarettes, where close friends or an adult in the home who smoked was similarly found to be a factor in adolescents beginning to use combustible cigarettes in longitudinal studies [61],[62].

The ability to "do tricks" with e-cigarettes and the proliferation of videos of other young people doing tricks on social media is likely appealing to teens [24],[30]. These videos contribute to the social acceptance of vaping among teens [40]. In Measham et al.'s [40] study of adolescents in England, many teens responded that the ability to do tricks, called "cloud chasing" (p. 229), represents the main reason they vape. In another study in England, teens cited "fun tricks" (p. 5) as a significant reason for using e-cigarettes [47]. Teens in the US also focused on the tricks and expressed a preference for vaping devices that produce more vapor to facilitate these tricks [63].

The influence of peers is also visible in the adolescent preference for sharing videos and photos of themselves performing tricks with e-cigarettes [40]. Social media was cited by teens encouraging e-cigarette use [47] indicating that social media and peer approval are part of a cycle that catalyzes increased adolescent vaping. Government interventions should include utilizing social media to discourage teen vaping and further research into the mechanism of peer support and approval will assist in effective creation of such programs.

7.7 Perceived risk

Teens are misinformed about the realities and risks of vaping [30]. In a national study, perceived risk of e-cigarettes by adolescents was found to be the lowest of all illicit substances, including alcohol. Less than 20% of teens saw e-cigarettes as a great risk as compared with over 70% who saw great risk in smoking one or more packs of cigarettes daily [2]. In small groups, teens mentioned low levels of perceived risk as a reason they believe adolescents are drawn to vaping [47]. Teens have difficulty identifying risks associated with vaping while they are quick to bring up benefits, in contrast to cigarettes where they were hard pressed to find a benefit, aside from relaxation, but identified risks easily [64]. More than half of the students who reported using e-cigarettes vaping erroneously believed the mist inhaled only contained flavoring, according to a 2017 National Institute of Health study, demonstrating a complete lack of awareness of the inhaled substances and accompanying risks [25].

Increased harm perception is associated with a lower level of curiosity about e-cigarettes, suggesting that this low risk perception will cause more teens to be drawn into vaping [26,65]. The connection between low risk perception and initiating vaping holds true both for perception of absolute harm (i.e. that vaping is not harmful) and for perception of harm compared to traditional cigarettes (i.e. that vaping is harmful, but less harmful than combustible cigarettes). Teens who use e-cigarettes also have a low risk perception of tobacco in e-cigarettes and in traditional cigarettes relative to teens who haven't used e-cigarettes [10].

Misevaluating risk is also visible in the disparity between perceived and actual risk of sweet flavorings in e-cigarettes. Although the additives make flavoring a higher risk than vaping unflavored liquid, it was consistently evaluated as having less risk by teens [45].

7.8 Lack of psychological barriers

Certain psychological barriers present in traditional cigarettes due to physical manifestations of habitual smoking do not pertain to vaping. Specifically, undesirable side-effects of smoking including yellowed teeth, stained fingertips and halitosis, are not experienced by e-cigarette users [8]. Teen who identify as users, report that they are unaware that any studies have shown e-cigarettes to be unhealthy [63]. Instead, teens describe vaping as fun and highlight the ability to do tricks and the variety of enjoyable flavors [24],[40],[47]. Additionally, some flavored e-cigarettes share "sensory similarities" (p. 7) with sweet foods, further reducing psychological barriers to using flavored e-cigarettes [48]. These differences mean that even adolescents who might choose not to smoke combustible cigarettes may still consider using e-cigarettes. This discrepancy in attitude is demonstrated in the comparatively low disapproval rates of regular use of e-cigarettes as compared to other risky behaviors [2].

8. Policy ramifications

One of the critical aspects to consider when evaluating policy options is effectiveness [66]. A deep understanding of why teens are drawn to vaping is critical to identifying which policy options will be most effective. As cited, teens find the design, price point, ease of concealment, flavor and peer validation enticing. Furthermore, teens are misjudging the risks of vaping and are unaware of the true contents of vaping liquid. Policies that address these issues are more likely to be effective in curbing teen usage than policies that overlook these important factors.

9. Policy strategies

Using the prism of teen attitude can facilitate picking the most effective strategy. Policy efforts in the US have been centered around some external positive aspects of adolescent vaping, mainly flavor and price point, but could be expanded to address the lure of design and ease of concealment (see figure 1). For instance, Israel initially banned the selling of JUUL brand vape liquid citing the higher levels of nicotine as compared to other brands [67]. Policies like this do not specifically address factors of teen interest and if implemented in the US, teens would be likely to simply gravitate towards another brand.

In November of 2018, JUUL itself halted the sale of flavors online, ostensibly to self-regulate before such a policy could be enacted by the FDA [68]. Almost a year later, in September of 2019, JUUL announced that it will not fight a total flavor ban suggested by the White House [69]. In the same month, Israel enacted a full ban on flavors for all e-cigarettes [70]. This type of regulation addresses the fact that teens are drawn to flavors, but it does not address the design, price point, ease of hiding the devices or correct adolescent misimpressions regarding vaping.

In general, most policy alternatives do not address more than one aspect of the adolescent attitudes that contribute to teens vaping (see Table 2). Policies aimed at social acceptance and educating adolescents can improve risk perception and peer approval while financial disincentives address the fact that the low price point is enticing for teens. To address both the lure of easy concealment and the allure of design, the design of e-cigarettes would need to be regulated to be less compact and to be clearly distinguishable from USB devices. Alternatively, companies could be forced to include a mechanism in e-cigarettes which would provide a way to detect their presence. This approach may be more effective than banning USB devices in areas like schools, which has been the solution in some schools [71]. Policy regulating the

amount of vapor created by devices may also curtail the ability to do tricks and potentially impact peer validation. In order to effectively curb teen vaping, the most effective approach would seem to be a combination of these policy options coupled with a focus on educating students.

Table1: Adolescent Attitudes Addressed by Specific Policy Alternatives.

Adolescent Attitudes Addressed by Specific Policy Strategies						
Policy Strategy	**Peer approval**	**Flavor**	**Design**	**Price point**	**Ease of concealment**	**Risk perception**
Banning high nicotine content brads (e.g. JUUL)	no	no	no	no	no	no
Ban/restrict access to flavors	no	yes	no	no	no	no
Taxation or another financial disincentive	no	no	no	yes	no	no
Education of teens	yes	no	no	no	no	yes
Anti-vaping advertising campaign	yes	no	no	no	no	yes
Regulation of design	no	no	yes	no	yes	no
Regulate advertising and internet sales	no	no	no	no	no	no
Require warnings and information on packaging	no	no	no	no	no	yes

Policies that have the goal of making e-cigarettes less available to adolescents should be considered separately from those that seek to discourage teens from this behavior. These policies, such as regulating advertising or limiting internet sales, should be part of the larger effort to curb adolescent vaping through education and policies aimed at making e-cigarettes less enticing to teens.

10. Conclusion

Teen vaping is a current issue that needs to be addressed by federal and state policy. Teens are dangerously misinformed about what vape liquid contains and the potential risks of using e-cigarettes [25]. An appreciation, by teens, of the risks involved has been shown to lower the level of curiosity and willingness to experiment with vaping [65]. The focus of policy efforts should be informing teens about the risks of e-cigarette and further efforts to curbs availability and appeal of e-cigarettes for the teen population.

The CDC [72] recommendations for community and policy initiatives to cut down on adolescent vaping include media campaigns aimed at educating adolescents to the dangers of tobacco use, raising the price of tobacco products and enacting smoke-free air laws that include e-cigarette [72]. These approaches address certain aspects of teen interest, such as price point as well as educating young people about the dangers of using tobacco but it does not touch upon numerous other facets of teen interest. A broader approach that addresses more aspects of teen interest is recommended. Specifically, policy around banning or restricting sales of flavored e-cigarette liquid as well as regulation aimed at making vapes less appealing and harder to conceal, should be added to current policy.

Additionally, although many policies regarding vaping have been implemented, very little evaluative research on their effectiveness has been conducted [12]. Research into the effectiveness of education for teens about the risks and realities of vaping and anti-vaping advertising is also needed [73]. Additionally, further research into the effectiveness of specific policies in states, foreign countries and even college campuses will help to identify policies that will be most effective at discourage teen usage. The path forward should be illuminated by a combination of evaluative data on previous policy efforts and a comprehensive understanding of teen interest in vaping in order to successfully curb teen usage of e-cigarettes.

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