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PRACTICAL THEORIST

Electronic Nicotine Delivery Systems:

Juuling, Other Trends, and Community Prevention

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Smoking: Still a Major Public Health Problem

Smoking is the leading cause of preventable disease and death in the United States. Despite a decline in smoking in the past 50 years, (Centers for Disease Control and Prevention (CDC), 2016) 40 million adults and more than three and a half million adolescents (CDC, 2018) continue to smoke. As a result, 16 million Americans are living with a disease caused by tobacco use and about 1,300 people die each day of smoking-related illnesses (CDC, 2018).

Traditional cigarettes remain popular among adults, whereas adolescents and young people are more likely to use flavored tobacco in different products like mentholated cigarettes, cigars, or hookahs (U.S. Department of Health and Human Services (USDHH), 2014). Electronic nicotine delivery systems (ENDS) became increasingly popular among young people in the last ten years. These devices have many names: e-cigarettes, e-cigs, cigalikes, vaporizers, vape pens, e-hookahs, tanks, and mods. In 2017, e-cigarettes were the most commonly used tobacco product among high school students (11.7%), followed by cigars (7.7%), and cigarettes (7.6%) (CDC, 2018). The use of these products may result in a new generation of young people developing nicotine addiction and its associated health risks.

The Changing Landscape of Nicotine Delivery

Tobacco manufacturers have been modifying the chemical composition of cigarettes since the 1800s. One of the first changes came in the form of high-nicotine cigarettes blended with licorice and sugars (USDHH, 2016). These additives made cigarettes easier to inhale by softening the harshness of tobacco. In the mid-1900s, tobacco manufacturers added chemicals like menthol, other flavors, and ammonia—which increased the speed at which nicotine reached the brain (Truth Initiative, 2018). In their ongoing efforts to make cigarettes appear “safer,” “cleaner,” and “less harmful,” they also introduced filters as well as light and low-tar cigarettes (USDHH, 2016).

With each modification came unfounded health claims that mislead the public on the true effects of smoking. In 2014,

the Surgeon General’s report stated that *“the evidence is sufficient to conclude that the increased risk of” death and disease — specifically lung cancer — “results from changes in the design and composition of cigarettes since the 1950s.”* (Truth Initiative, 2018) Following a similar pattern, tobacco manufacturers are working to expand their customer base with electronic nicotine delivery products.

The first “electric vaporizer” was conceptualized by Joseph Robinson in 1927 (Robinson, 1930). Its design resembled the cylindrical shape of a cigarette and was intended to heat chemical compounds into a vapor. Thirty-five years later, Herbert Gilbert patented and developed “a smokeless non-tobacco cigarette” that produced vaporized steam without nicotine (Gilbert, 1965). Independent inventors and tobacco manufacturers have since built on this idea of heating-without-burning nicotine products by developing and popularizing electronic nicotine delivery systems. Devices created in 1990s and early 2000s resembled traditional cigarettes and used heat to vaporize flavored liquids and nicotine.

Chinese pharmacist Hon Lik is often credited with the development of the first modern e-cigarette in 2004. This product aimed to reduce the harm associated with cigarette smoke by eliminating tar created by combustible cigarettes. Lik argued that “the advantages of the present invention include smoking without tar, significantly reducing the carcinogenic risk. Furthermore, users still feel as if they are smoking and experiencing the same excitement, and the cigarette has no need to be lit and is no fire risk.” (Lik, 2004)

This Practical Theorist is part of a series of publications designed to summarize field research on key drug use issues and to present it in a concise, practical format, with strategies for using the data to mobilize communities and support your coalition’s mission.

ENDS became available in the US in 2007, and started looking like modifiable pen-like and tank-style systems, as well as sleek and discreet devices that resemble USB memory sticks. As of 2018, all major tobacco manufacturers have entered the ENDS market.

Smoking Versus Vaping: What's The Difference?

Traditional cigarettes are made with tobacco, chemical additives, and a filter, encased by paper wrapping (U.S. Food and Drug Administration (FDA), 2018). Cigarette smoke contains close to 7,000 chemicals that enter the lungs, pass into the blood stream, and travel to every organ in the body. Almost 70 of these chemicals have been linked to different cancers and diseases (USDHH, 2014). Decades of research have shown that cigarette smoke is not only harmful to the smoker, but also to anyone exposed to second-hand smoke (USDHH, 2014).

ENDS were designed to eliminate the combustion process of a traditional cigarette. These battery-powered devices transform liquids (e-liquid), wax, or dried herbs into aerosol by heating them to their boiling temperature. The process of inhaling the aerosol is referred to as vaping. This is different from smoking because the user is not inhaling tar and other carcinogenic parts of a burning cigarette.

Flavor of the Month

Tobacco manufacturers have a long history of blending tobacco with other flavors to reduce harshness and increase appeal. Mentholated cigarettes, for example, are often used as starter cigarettes because menthol weakens the harshness of tobacco and produces a cooling effect, making smoke easier to inhale (Anderson, 2011). It is not surprising then that about half of youth who try smoking for the first time use a flavored cigarette (Ambrose, et. al., 2019), and 12 to 17-year-olds who smoke are more likely to use menthol than non-menthol cigarettes (Truth Initiative, 2018). While non-menthol cigarette use has been declining over the past decade, menthol cigarette use increased almost 2% among 18-25 year-olds, and nearly 1% among adults 26 and older between 2004 and 2014. (Truth Initiative, 2018) Menthols remain especially popular among African-Americans, Hispanics, Asians, members of the LGBT community and women (Lester & Gagosian, 2017).

The makers of tobacco products are capitalizing on this trend by developing a wide range of flavored products aimed at youth, young adults, and other vulnerable populations. By embracing technology, marketing to youth, and using the language of “harm reduction,”



ENDS manufacturers introduced a new way to consume nicotine. As a result, the use of ENDS products among high schoolers increased from 1.5% in 2011 to close to 12% in 2017 (CDC, 2018). Many first-time users are youth who have not experimented with traditional tobacco products (CDC, 2018). Most ENDS contain nicotine and other toxic chemicals that may lead to poisoning, addiction, and cancer (Rubinstein, et. al., 2018), and use of these products can harm adolescents' developing brain (CDC, 2018).

Electronic Nicotine Delivery Systems (ENDS)

There are more than 460 ENDS products on the market at last count. They vary widely in design, capacity, and chemical composition (Zhu, et. al., 2014).

Main components of an ENDS device include:

- mouthpiece used to inhale
- heating element (atomizer)
- power source (usually a battery)
- cartridge which holds a liquid solution (e-liquid)

What's in the E-Liquid?

Nicotine—the addictive chemical in tobacco and a major component in the e-cigarette liquid. Most ENDS contain nicotine; some contain the same amount per puff as traditional cigarettes. However, nicotine content tends to vary widely among products; (National Academies of Science, Engineering, and Medicine (NASEM), 2018) and brands like JUUL began using nicotine salts, which allow users to inhale large levels of nicotine more easily and with less irritation (CDC, 2018).

Humectants—substances that help create aerosol when heated, giving ENDS the ability to mimic cigarette smoke. PG (propylene glycol) and glycerol (vegetable glycerin) are the most popular e-liquid humectants. PG is safe to ingest as a food and pharmaceutical additive; it is also used to



create artificial fog in theatrical productions. However, long-term exposure to these substances, along with dozens of other chemicals that are often not listed on labels, can be toxic (NASEM, 2018).

Flavorings—additives that come in more than 7000 flavors (Zhu, 2014). Many flavors are safe to ingest when added to food products, but can cause problems with breathing when inhaled (NASEM, 2018).

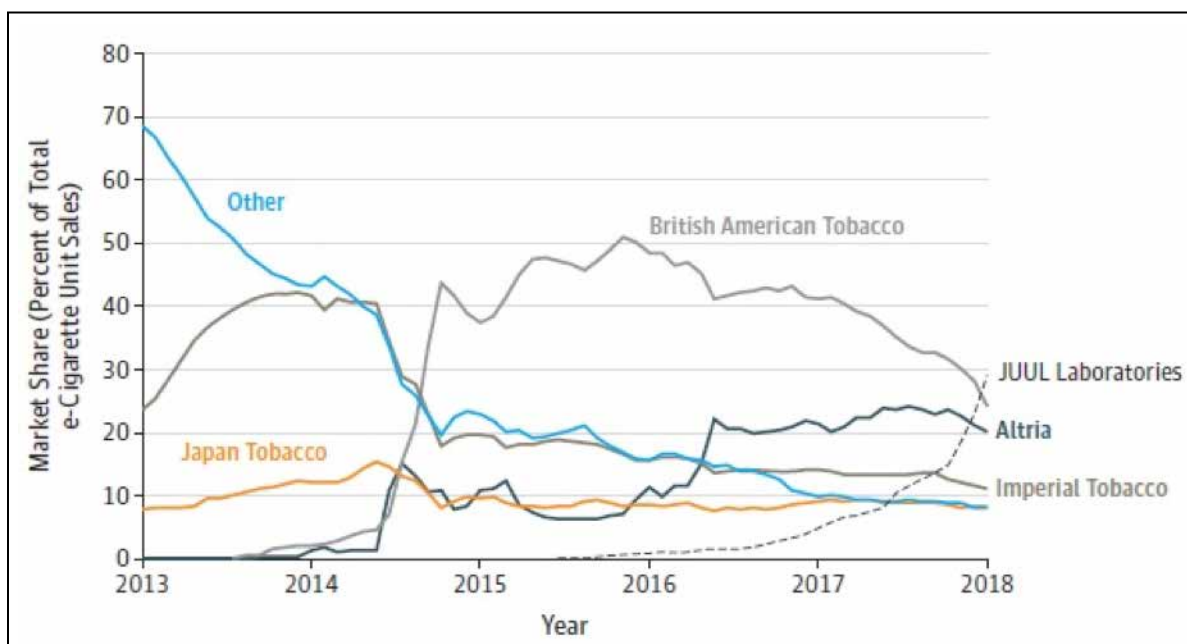
Metals—residue from coils used to heat up e-liquid as well as other parts of the device can leak into the aerosol that is inhaled by the user. Chromium, nickel, lead, manganese, aluminum, tin, and iron have been detected in ENDS aerosols (NASEM, 2018).

JUULing

JUUL entered the market in 2015 and has since become the most popular e-cigarette brand among youth and young adults: 8% of young people aged 15-24 used JUUL in 2017 (Willett, et. al., 2018). Teenagers are 16 times more likely use JUUL compared to 25 to 34-year-olds, (Truth Initiative, 2018) and they are using it regularly (Vallone, et. al., 2018). The use of this device is commonly referred to as JUULing.

JUUL is composed of a battery, a temperature regulating system, and a pre-filled “JUULpod” containing nicotine and other chemicals. **One JUULpod contains as much nicotine as a pack of cigarettes** (Willett, et. al. 2018). The defining characteristic of this device is its design: JUUL resembles a USB memory stick and is rechargeable via a USB port. Its design and flavors are particularly appealing to young people: the discreet look allows teens to conceal the device from parents and use it at home and in classrooms, (Chen, 2017) and the pods come in fruit and crème flavors.

JUULs and JUULpods are also less expensive by nicotine dosage than traditional cigarettes. A JUUL device currently retails for \$35, with vape shops offering discounted prices of \$20; and a four-pack of JUULpods costs close to \$16—one JUULpod contains as much nicotine as a pack of cigarettes (Willett, et. al. 2018). Given the lack of product regulations on ENDS devices, JUULs have been available not only at tobacco and vape shops, but at gas stations and convenience stores. For this reason, the majority (74%) of JUUL users under 18 tend to obtain JUULs at physical retail shops and only 6% online (Truth Initiative, 2018). More than half have additional access through friends and family.



ENDS Sales Market Share in United States, 2013-2017

Source: King, B. A., Gammon, D. G., Marynak, K. L., & Rogers, T. (2018). Electronic cigarette sales in the United States, 2013-2017. *JAMA*, 320(13), 1379-1380.

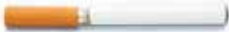




Tobacco Heating System (IQOS)

The Journal of Tobacco Control published a comprehensive issue on the effects of heat-not-burn tobacco products, with a focus on IQOS in 2018. Short for I Quit Ordinary Smoking, IQOS is an electronic nicotine delivery product created and sold by Philip Morris International (PMI). Currently, IQOS is available outside of the U.S. and is pending approval for domestic sale from the Food and Drug Administration (FDA).

Using PMI’s publicly available data, independent researchers found no statistically significant differences in biomarkers of American and Japanese people who used IQOS compared with those who smoked (Glantz, 2018). Moreover, smokers who switched to IQOS did not show reduced lung inflammation; while animal testing showed an association between IQOS exposure and inflammation of the lungs (Moazed, et. al., 2018). Further, IQOS use lead

to damaged blood vessels and heart (Nabavizadeh, et. al., 2018).

Researchers also examined PMI’s claim that IQOS contains fewer toxic chemicals than traditional cigarettes. PMI reported 58 substances that make up IQOS aerosol—40 of which are considered harmful and potentially harmful constituents (HPHCs) by the FDA. All 58 substances showed lower amounts of toxic emissions than traditional cigarettes. Based on this claim, PMI aims to market IQOS as a harm reduction product. A closer examination of the data showed that IQOS aerosol contains 113 substances, 57 of which were not reported by PMI. 50 of these substances are carcinogenic, and 56 have higher chemical concentration than traditional cigarettes (St. Helen, et. al., 2018). Long-term health effects of some of these substances are not yet known.

Type of Product	Nicknames	Distinguishing Characteristics
First-Generation	Electronic cigarette Cig-a-likes Minis 	<ul style="list-style-type: none"> Physically similar to cigarettes Come in disposable or rechargeable forms May emit a light when the user puffs Shorter battery life than later generations Generally less expensive
Second-Generation	Vape pens Mid-sized e-hookah 	<ul style="list-style-type: none"> Short for “vaporizer pen” Come in various sizes Not shaped like a cigarette Slim like a pen Can come in disposable or rechargeable forms Refillable with e-juice/e-liquid
Third-Generation	Mechanical Modified Nicotine Delivery Systems (MODs) Vape MODs/personal vaporizer 	<ul style="list-style-type: none"> Larger in shape and size Include modification options Have larger battery capacity and replaceable batteries Typically rechargeable Typically deliver more nicotine than earlier generations
	Electronic hookah 	<ul style="list-style-type: none"> Electronic versions of hookah head and hookah bowl
	JUUL 	<ul style="list-style-type: none"> Resembles a USB flash drive Available in several flavors sold as ‘pods’ which contain nicotine and attach to the device Has a subtle and sleek design that can easily be hidden from parents or teachers Can be recharged in a laptop or any USB charger

Source: <https://www.centeronaddiction.org/e-cigarettes/recreational-vaping/what-parents-should-know-about-different-vaping-devices>



Federal Regulations

The U.S. Food and Drug Administration (FDA) is the federal agency responsible for regulating tobacco products. In 2016, the FDA extended its regulatory authority to include ENDS (FDA, 2016). This decision allowed the FDA to:

- restrict ENDS sale to youth under 18
- restrict sale in vending machines
- ban the distribution of free samples
- require that new products meet public health standards
- review ingredients and product design
- review health risks and appeal to youth

The FDA began issuing warnings to tobacco and vape shops that sold tobacco products resembling candy, juice boxes, and other packaging that appeals to young people and uses false advertising (FDA, 2018). With increased vaping among youth, the FDA plans to strengthen federal-level regulations by banning the sale of most flavored e-cigarettes at gas stations and convenience stores, imposing age verification for online sales, and possibly banning menthol cigarettes (McGinley, 2018).

Recent Research

ENDS aerosol generally contains fewer toxic chemicals than traditional cigarette smoke (CDC, n.d.). For this reason, the CDC states that “*e-cigarettes have the potential to benefit adult smokers who are not pregnant if used as a complete substitute for regular cigarettes and other smoked tobacco products*” (CDC, 2018).

However, whether ENDS lead to fewer health problems for adult smokers still needs additional research. ENDS are relatively new products that have not been studied extensively and the “amounts of nicotine and other substances in these products can vary widely because they are not standardized.” (American Cancer Society, 2017) Many studies detected dozens of chemicals in ENDS aerosols which were not included on labels, creating additional challenges for researchers. Therefore, studies on long-term effects of e-cigarette use have been inconclusive.

Similarly, the science on the role that ENDS may play in smoking cessation is mixed. For example, some researchers argue that adults who use e-cigarettes as a smoking cessation aid are less likely to quit than those who do not use ENDS (Weaver, et. al. 2018). While others state that

the use of ENDS helps increase the amount of times a smoker tries to quit smoking, (Zhu, et. al., 2017) which can improve the odds of cessation (Zhu, et. al., 2012).

When it comes to youth, the dangers of e-cigarettes are more clear. The U.S. Surgeon General warns that “e-cigarette use poses a significant—and avoidable—health risk to young people” (USDHH, 2016). The brain continues to develop until age 25, and young people are especially at risk for developing long-term problems associated with nicotine and other substance use.

Perception of Harm

Adults and young people report believing that ENDS are the least harmful products across all substance categories (Johnston, et. al., 2016). In 2012, 13% of adults thought that e-cigarettes were equally or more harmful than cigarettes—this number rose to 40% in 2015. During this time, the number of adults who thought e-cigarettes are addictive also increased from 32% to 68% (Majeed, et. al., 2017).

21% of 12 grade students reported vaping nicotine in 2018. This is nearly double the number reported in 2017 (11%) (Miech, R.A., et. al., 2018). This increase is the largest ever seen in 30-day use data from 12th graders. The reported increase in nicotine use in 12th graders from 2017 to 2018 (from 23.7% to 28.5%) can also be attributed to vaping. This increase in vaping can also be seen in 8th and 10th graders: the number who reported vaping in 2018 went from 13.3% and 23.9% in 2017 to 17.8% and 32.3% in 2018. While the use of other types of tobacco are decreasing, vaping use is increasing at alarming rates (NIDA, 2018).

It is important to note that 8th graders were more likely to think e-cigarettes are harmful than 12th graders. Yet the percentage of 12th graders who thought e-cigarette use was harmful increased when researchers asked about “vaping nicotine.” This finding suggests that adolescents differentiate between nicotine and non-nicotine e-liquids and find the ones without nicotine less harmful. Many young people do not even know or realize which products do or do not contain nicotine.

The Role of Community Coalitions

A review of population-level smoking cessation interventions between 1991 and 2010 found no consistent trend in cessation among smokers in the U.S., with an

average of 4.4% of smokers quitting annually (Zhu, et. al., 2012). Given how difficult it is to stop nicotine addiction, it is imperative to prevent this problem before it begins.

Community coalitions play a large role in substance misuse prevention—including prevention of tobacco use among young people. Through their local efforts, coalitions impact regulations, availability, and norms surrounding tobacco use. They enable residents to contribute by creating the political will necessary to influence the development and implementation of lasting policy.

Building on decades of evidence and positive results in protecting youth from tobacco exposure, coalitions are well equipped to use their existing partnerships and local prevention infrastructure to target ENDS use. Coalitions can begin by defining the geographic region that they are going to address. Then, assess the community conditions where ENDS use takes place; engage all appropriate sectors of the community to have the broadest impact; and develop a comprehensive plan that will reach individuals as well as the overall community environment.

The Seven Strategies for Community Change

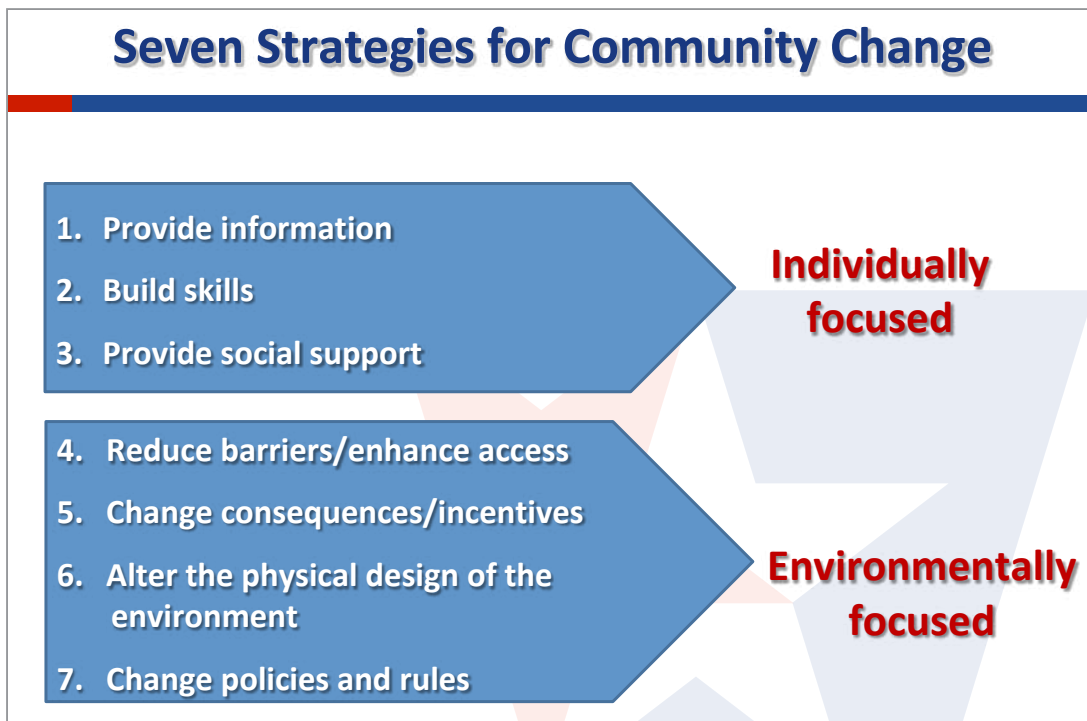
The Seven Strategies for Community Change were developed between the University of Kansas Work Group researchers and coalition experts in 2005 at the Community Anti-Drug Coalitions of America

(CADCA) conference. For the first time, the individual and environmental strategies were combined into a comprehensive framework inclusive of the entire community. This framework guides coalition efforts to prevent substance use and addiction in their communities. Its success has been studied, and the results have contributed to the growing scholarship on comprehensive approaches to building healthy communities (Yang, et. al., 2012). The history of prevention efforts to reduce tobacco use provides communities with a volume of tools for community prevention. These tools can be used by coalitions, using the framework of the Seven Strategies, to provide comprehensive efforts against ENDS.

Prevention Works: Lessons from Tobacco Control

Identify At-risk Populations

A review of ENDS use across sociodemographic groups found that older adolescents and young adults are the most aware of ENDS products and are the most likely to use them. ENDS users are also likely to be white and male with a higher educational attainment. Some studies suggest that people with mental health disorders or members of the LGBTQ community may be at risk or targeted by tobacco companies regarding ENDS use (Hartwell, et. al., 2016). Additionally, studies that examined vape shop density found a higher number of vape shops





in urban than non-urban areas, concentrated in poorer neighborhoods (Dai, Hao, & Catley, 2017) and next to college campuses (Dai & Hao, 2016). Exposure and accessibility to ENDS products may place these populations at higher risk for ENDS initiation and use.

Target Factors that Contribute to ENDS Use

The U.S. Surgeon General outlines a comprehensive approach to addressing emerging ENDS use among young people (USDHH, 2016):

- Educate parents, teachers, coaches, health professionals, and other influencers about the risks of e-cigarette use among youth and young adults
- Curb e-cigarette advertising and marketing that are likely to attract youth and young adults
- Develop e-cigarette and smoke-free indoor air policies
- Restrict youth access to e-cigarettes in retail settings
- Require retail licensing and establish specific package requirements
- Coordinate, evaluate, and share best practices across state and local organizations
- Support and reinforce e-cigarette regulations at the federal, state, and local level

- Address surveillance, research, and evaluation gaps related to e-cigarettes

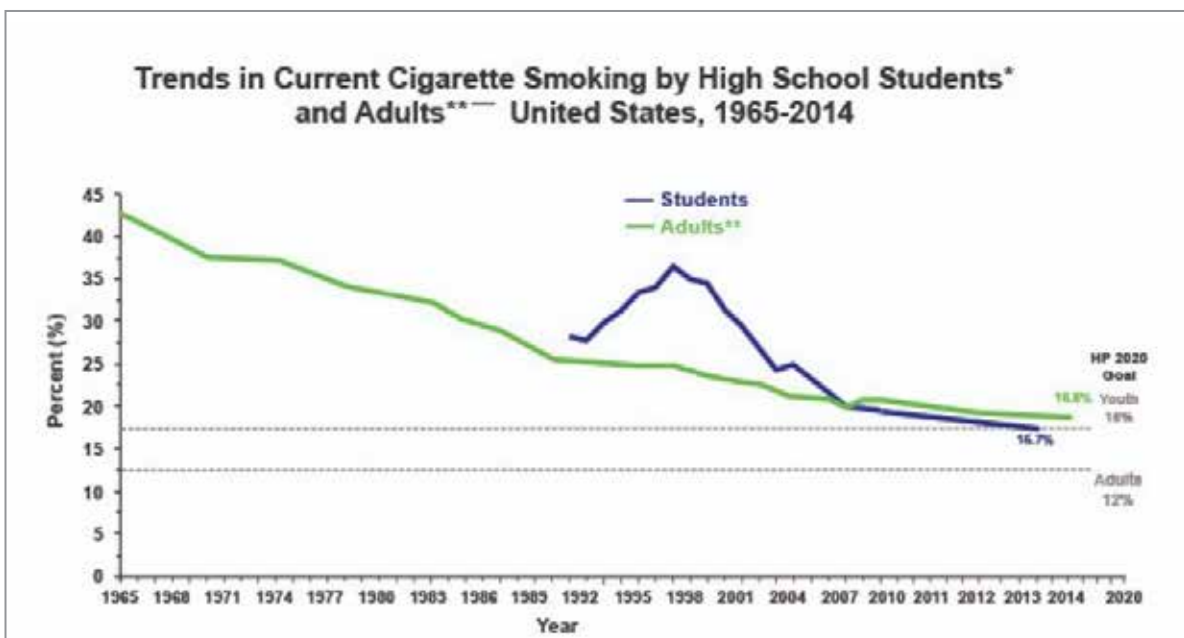
This approach builds on proven prevention interventions in tobacco control which helped steadily reduce youth smoking in the past decade (USDHH, 2012):

- Youth-targeted mass-media counter marketing campaigns
- Adoption of comprehensive smoke-free laws
- Increased availability of accessible, affordable tobacco cessation options
- Increased retail price of tobacco products through excise tax increases
- Restrictions on advertising and promotion

Evidence-based Interventions

The creation of scientific evidence for ENDS use prevention interventions is just beginning—it may take several years before ENDS-specific evidence-based interventions are identified by public health researchers.

The *Community Guide* outlines comprehensive tobacco control programs—multi-strategy population-level interventions to reduce tobacco use that increase cessation, reduce secondhand smoke exposure, and prevent initiation among young people. These



Source: Centers for Disease Control and Prevention (CDC)(2016). Trends in current cigarette smoking among high school students and adults, United States, 1965–2014.

interventions are designed to help communities and can be incorporated by coalitions across the country. All interventions, full descriptions, and the findings and rationale statement can be found at www.thecommunityguide.org.

1. Tobacco Use and Secondhand Smoke Exposure: Comprehensive Tobacco Control Programs

This intervention outlines a comprehensive approach to tobacco use prevention that combines educational, clinical, regulatory, economic, and social strategies. It directly complements coalition work and suggests coordination between community and state-level prevention efforts such as Quitlines and health systems coordination.

2. Tobacco Use and Secondhand Smoke Exposure: Mass-Reach Health Communication Interventions

The use of media to reach large numbers of people is an effective way to address the dangers of smoking and nicotine addiction. This intervention requires health communication in all media outlets, including digital media, radio, and other forms of media with which coalitions work.

3. Tobacco Use and Secondhand Smoke Exposure: Interventions to Increase the Unit Price for Tobacco Products

Taxing tobacco products is a growing practice in most jurisdictions. Evidence-based findings demonstrate that a 20% increase in the price of tobacco products is enough to discourage their purchase. Collecting higher taxes on electronic nicotine delivery systems would be an effective way to discourage their use.

4. Tobacco Use and Secondhand Smoke Exposure: Smoke-Free Policies

This intervention affirms the use of public-space and private-sector indoor smoking policies. These local policies are an effective alternate to legislative action and are growing in popularity. Given the lack of information on the content of ENDS aerosols, it should not be difficult to promote vape-free policies.

5. Tobacco Use and Secondhand Smoke Exposure: Quitline Interventions

State governments are important coalition allies. When

people don't know where to turn when they're ready to quit, state-sponsored Quitlines can give important referrals to services and provide support when breaking the addiction to nicotine becomes difficult.

6. Tobacco Use and Secondhand Smoke Exposure: Reducing Out-of-Pocket Costs for Evidence-Based Cessation Treatments

A visit to any pharmacy can yield several cessation products or other tools that help tobacco product users give up their habit. Working with policy-makers to reduce cost-related barriers to cessation treatments can be an important step in coalition-related efforts.

7. Tobacco Use and Secondhand Smoke Exposure: Mobile Phone-Based Cessation Interventions

Mobile phone-based interventions deliver evidence-based information, strategies, and behavioral support directly to tobacco users who want to quit. Content may be tailored to special populations and may be especially helpful to young people (Text2Quit, 2018).

8. Tobacco Use and Secondhand Smoke Exposure: Incentives and Competitions to Increase Smoking Cessation Among Workers – When Combined with Additional Interventions

Engaging workers in behavior change exercises includes offering competitions, monetary awards, gift cards or some other type of positive reward. It is an effective way to reduce the use of tobacco products in work place settings and should be operationalized alongside another intervention like Quitlines or mobile phone-based cessation interventions.

9. Tobacco Use and Secondhand Smoke Exposure: Community Mobilization with Additional Interventions to Restrict Minors' Access to Tobacco Products

This intervention encourages the development of community awareness and support for reducing youth tobacco use and access to tobacco products from commercial sources. It should be combined with interventions that target product regulations and sales, locally.

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