Senator Claxton, Representative Meyer and members of the Joint Standing Committee of Health and Human Services , my name is Dr. Norma Dreyfus and I am a retired Pediatrician in Arrowsic and am here to testify in favor of LD 1550, An Act to End the Sale of Flavored Tobacco Products.

Tobacco kills and harms. There are approximately 4500 tobacco related deaths each year in the United States. Lives are cut in half by adults who are long term users. Tobacco smoking during pregnancy accounts for 17% of sudden infant deaths and there is increased risk of stillbirth, placental-associated complications, and preterm birth. (1) The effects of tobacco smoke on the development of asthma begins in utero with untoward fetal lung changes. Not only is smoking involved in the development of asthma, but asthma's prevalence and severity is increased in a smoke environment. The risk of middle ear disease, childhood overweight, learning and neurobehavioral problems, and preclinical atherosclerosis is also increased by 2 nd and 3rd hand smoke exposure.

Tobacco consumption is costly. A 2014 report of the Surgeon General stated that costs attributable to smoking were from $289-$332.50 billion per year in the United States, $132.5 to 175.9 billion attributed to direct medical care of adults and $151 billion to loss of productivity because of exposure to second hand smoke.(2)

E- cigarettes and flavored tobacco products pose a public health emergency
One of the best ways to stop this emergency is by prevention. Most adults who smoke started their smoking in adolescence, the majority having started nicotine use by 18 years of age. Over the last 20 years adolescent smoking had declined given the state and federal campaigns and consistent negative advertising. That headway is now being reversed in the teen population because of the introduction of flavored tobacco products, especially with the electronic delivery systems and flavored cigars.(3) The availability of flavors was among the most prominently cited reasons for youth e-cig and cigar use. Many teens falsely belief that e-cigs with flavor are less harmful than tobacco flavors. A government survey revealed that 81% of youngsters who ever used tobacco products started with a flavored product and 81.5% who have ever tried e-cigarettes and 73.5% who ever tried cigars state that they did so because of the flavors.(4) E-cigs threaten to addict a generation of young people. T here is increasing data that adolescents and young adults who do use e- cigs are at higher risk to transition to the use of traditional cigarettes. Several well-designed longitudinal studies show that adolescents and young adults aged 14-30 are 3.6 times more likely to be using conventional cigarettes on follow-up if they have used e-cigarettes than those who have not. (3)

In 2016 the Surgeon General reported that electronic cigarettes are unsafe for children and adolescents. (3) The executive function and neurocognitive processes of the brain are not fully developed in early adolescence. The psychoactive ingredient in e cigs is nicotine which has a neurotoxic effect on the developing brain. The amount of nicotine in the electronic systems varies widely and there is often discrepancy with the quantity on the label. Some amounts are equal to or exceed what is in a conventional cigarette. Nicotine is addicting and the adolescents are physiologically more vulnerable. The earlier the age of use of nicotine containing products,

the stronger the addiction and the more difficult it becomes to quit. This puts adolescents at risk of the marketing schemes of the tobacco industry. As stated by Nancy Brown in 2017 as CEO of the American Heart Association "The tobacco industry is relen tless in its pursuit to recruit the next generation of addicted users at an early age, exploring new technology and appealing flavors to seal their deadly deal".

Toxicants and carcinogens are found in the delivery solutions of the electronic systems. (3) These include aldehydes, tobacco-specific nitrosamines, metals, tobacco alkaloids and polycyclic aromatic hydrocarbons. Some ingredients have also been shown to be toxic to human embryonic stem cells. Many of the flavoring chemicals contain aldehydes, a respiratory irritant, in sufficient concentration to be of toxicological concern.
There is a lung toxicity resulting from e-cigarette use. It is known by the eponym EVALI: e-cigarette or vaping product use-associated lung injury.

Vote in favor of LD 1155. Flavored tobacco products attract kids. Prohibiting their use will halt the progression to tobacco use as well as the adverse effects of the electronic systems themselves. This bill does both. I urge you to vote in favor of LD 1155.

Thank you, and I would be happy to respond to any questions you may have.

(1) Section on Tobacco Control; Public Policy to Protect Children from Tobacco, Nicotine and Tobacco Smoke, Pediatrics 2015; 136; 998

http://pediatrics.aappublications.org/content/136/5/998

(2) Farber, H.; Groner, J; Walley, S; Nelson, K; Section on Tobacco Control; Protecting Children From Tobacco, Nicotine and Tobacco Smoke; Pediatrics 36 Number 5 Nov 2015

http://pediatrics.aappublications.org/content/136/5/e1439

(3) Jensen, B; Walley, S; Section on Tobacco Control; E cigarettes and Similar Devices; Pediatrics 2019,143

http://pediatrics.aappublications.org/content/143/2/e20183652

(4) News Release American Academy of Pediatrics 3/15/2017;
Booming Market of Candy- Flavored E-cigarettes and Cigars Threatens to Hook a New Generation of Kids, New Report Warns
https://www.lung.org/media/press-releases/booming-market-of-candy-flavored-e-cigarettes

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

Public Policy to Protect Children From Tobacco, Nicotine, and Tobacco Smoke

SECTION ON TOBACCO CONTROL

abstract

Tobacco use and tobacco smoke exposure are among the most important health threats to children, adolescents, and adults. There is no safe level of tobacco smoke exposure. The developing brains of children and adolescents are particularly vulnerable to the development of tobacco and nicotine dependence. Tobacco is unique among consumer products in that it causes disease and death when used exactly as intended. Tobacco continues to be heavily promoted to children and young adults. Flavored and alternative tobacco products, including little cigars, chewing tobacco, and electronic nicotine delivery systems are gaining popularity among youth. This statement describes important evidence-based public policy actions that, when implemented, will reduce tobacco product use and tobacco smoke exposure among youth and, by doing so, improve the health of children and young adults.

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STATEMENT OF PROBLEM

Tobacco use is one of the most important health threats to children, adolescents, and adults. Tobacco use harms not only individual tobacco users but also others who are exposed through secondhand and thirdhand tobacco smoke exposure. More than half of US children are regularly exposed to tobacco smoke. The vast majority of tobacco and nicotine dependence starts before 18 years. Effective tobacco control policies can decrease tobacco's toll on children's health.

This statement describes public policy recommendations to protect children from tobacco. Evidence quality is graded and recommendations generated as per Fig 1. An accompanying technical report describes the evidence to support these recommendations.[1] An accompanying policy statement describes clinical practice recommendations.[2]

DEFINITIONS

- Tobacco product: any nicotine delivery product, currently regulated or unregulated by the US Food and Drug Administration (FDA), which is not approved for safe and effective tobacco dependence treatment.

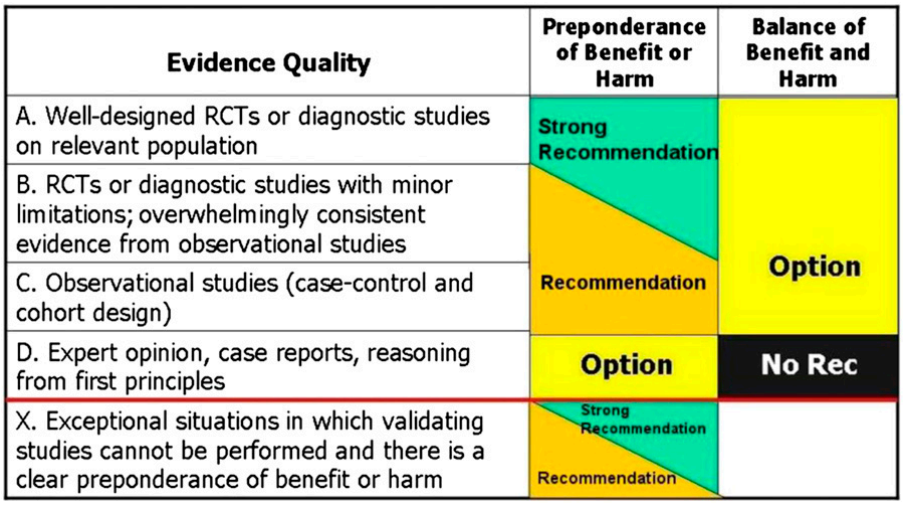

FIGURE 1
Evidence quality. RCT, randomized controlled study.

- Secondhand smoke: the smoke emitted from a tobacco product that is inhaled by a nonuser.
- Thirdhand smoke: the tobacco smoke that is absorbed onto surfaces and exposes the nonuser by either direct contact and dermal absorption and/or off-gassing and inhalation. Thirdhand smoke may react with oxidants and other compounds in the environment to yield secondary pollutants.
- Involuntary tobacco smoke exposure: The tobacco smoke exposure of nonusers. Involuntary exposure includes both secondhand and thirdhand exposure.
- Electronic nicotine delivery systems: handheld devices that produce an aerosol from a solution typically containing nicotine, flavoring chemicals, and carrier solvents such as propylene glycol and vegetable glycerin (glycerol) for inhalation by the user. Alternate names for these products include electronic cigarettes, e-cigarettes, e-cigs, electronic cigars, e-cigars, electronic hookah, e-hookah, hookah sticks, personal vaporizers, mechanical mods, vape pens, and vaping devices.

NEW INFORMATION

Benefits to children's health of clean air legislation, including comprehensive smoking bans, have been clearly documented.[3] Children and adolescents are harmed by involuntary tobacco smoke exposure in vehicles,[4] in multi-unit housing,[5,6] and from outdoor smoking in congested areas.[7,8] Among youth, the use of tobacco and nicotine products other than cigarettes (cigars, little cigars and cigarillos, hookahs, dip, chew, snus, electronic nicotine delivery systems, and others) is on the rise.[9] Many adolescents who smoke cigarettes are dual or multiple users; that is, they use a combination of different tobacco products.[10]

BACKGROUND

Tobacco is unique among consumer products in that it causes disease and premature death when used exactly as intended. The 2014 US Surgeon General's Report concluded: "This year alone, nearly one-half million adults will still die prematurely because of smoking. If we continue on our current trajectory, 5.6 million children alive today who are younger than 18 years of age will die prematurely as a result of smoking."[3] In the United States (2005–2009 data), nearly 1000 infant deaths per year, or approximately 8% of all infant deaths and 17% of all sudden infant death syndrome cases, are attributable to tobacco smoking and tobacco smoke exposure.[3]

Tobacco smoke exposure harms children from conception forward, either causing or exacerbating the risks of preterm birth, low birth weight,[11] congenital malformations,[12] stillbirth, sudden infant death,[13–16] childhood obesity,[17–20] behavior problems, neurocognitive deficits,[21,22] wheezing,[23,24] more severe asthma,[25–30] more severe bronchiolitis, pneumonia,[31] middle ear infection, reduced lung function, cough,[24] and cancer.[32,33] Emerging data point to secondhand tobacco smoke exposure not only as a risk factor for development of childhood cancers[24] but as a factor that may increase the likelihood of smoking among young adult cancer survivors.[34] Secondhand tobacco smoke exposure is also associated with decreased glomerular filtration rate[35] and preclinical atherosclerosis[36,37] in adolescents. Recent research suggests that exposure to tobacco smoke can lead to symptoms of dependence in children who do not use tobacco.[38,39] There is no safe level of tobacco smoke exposure.[24]

Nearly 90% of tobacco-dependent adults initiated their tobacco use well before their 18th birthday.[40] The developing brains of children and adolescents are particularly vulnerable to nicotine. Although adolescent tobacco use in the United States has decreased substantially since the 1970s, it remains a considerable problem.

Electronic nicotine delivery systems are rapidly rising in popularity among youth and threaten to addict a new generation. The National Youth Tobacco Survey reported that from 2011 to 2014 current (within past 30 days) electronic cigarette use rose from 0.6% to 3.9% of middle school and 1.5% to 13.4% of high school students—increases of 650% and 890%, respectively.[41,42] Electronic cigarette use among use among youth

TABLE 1 Tobacco Control Policy Resources

1. CDC Best Practices for Comprehensive Tobacco Control Programs—2014
   Available for download at http://www.cdc.gov/tobacco/stateandcommunity/best_practices
   This is an evidence-based guide to help states plan and establish effective tobacco control programs to prevent and reduce tobacco use. The guide describes an integrated programmatic structure for implementing interventions proven to be effective and provides levels of state investment to prevent and reduce tobacco use in each state. Recommended funding levels for tobacco control programs for each state in the US are described.
2. World Health Organization (WHO) Framework Convention on Tobacco Control
   Available for download at http://www.who.int/fctc/about/en
   The WHO Framework Convention on Tobacco Control was developed in response to the globalization of the tobacco epidemic. It aims to tackle some of the causes of that epidemic, including complex factors with cross-border effects, such as trade liberalization and direct foreign investment, tobacco advertising, promotion and sponsorship beyond national borders, and illicit trade in tobacco products.
3. World Health Organization MPOWER
   http://www.who.int/tobacco/mpower/en
   MPOWER measures, which correspond to ≥1 articles of the Framework Convention, assist in reducing the demand for tobacco products at country level. MPOWER components include the following:
   Monitor tobacco use and prevention policies
   Protect people from tobacco smoke
   Offer help to quit tobacco use
   Warn about the dangers of tobacco
   Enforce bans on tobacco advertising, promotion, and sponsorship
   Raise taxes on tobacco
4. Campaign for Tobacco Free Kids
   http://www.tobaccofreekids.org
   The Campaign for Tobacco Free Kids advocates for public policies proven to prevent kids from smoking, help smokers quit and protect everyone from secondhand smoke.
5. Truth Initiative
   http://www.truthinitiative.org
   Known previously as the American Legacy Foundation, Truth Initiative was established in 1999 as part of the Master Settlement Agreement (MSA) among the major tobacco companies, 46 US states, the District of Columbia, and 5 US territories. Truth Initiative is dedicated to studying and providing public education about the impact of tobacco to reduce its use and associated death and disease. Under the terms of the MSA, Truth Initiative is restricted from advocacy or lobbying. However, Truth Initiative may educate the public on the addictive nature of nicotine and the dangers of smoking.
6. American Lung Association
   http://www.lung.org/stop-smoking/tobacco-control-advocacy
   The American Lung Association (ALA) includes tobacco control advocacy as part of its mission. In addition to other activities, the ALA prepares an annual report, "The State of Tobacco Control," and grades each state in the United States on its tobacco control efforts. The ALA is a leading voluntary health organization focused on improving lung health and preventing lung disease through education, advocacy, and research. Eliminating tobacco use and tobacco-related lung disease is a key part of the mission of the ALA.
7. US Department of Housing and Urban Development (HUD) Smoke Free Multifamily Housing: HUD's Action Plan to Create Smoke-free Multifamily Housing
   Available for download at http://portal.hud.gov/hudportal/HUD?src=/smokefreetoolkits1
   The purpose of HUD's Action Guide is to encourage public housing authorities and owners/agents of subsidized or market rate multifamily housing to adopt smoke-free policies.
8. American Academy of Pediatrics Julius B. Richmond Center of Excellence
   http://www2.aap.org/richmondcenter
   The Richmond Center provides the education, training, and tools to protect children from the harmful effects of tobacco and secondhand tobacco smoke.

is associated with greater rates of progression to regular (combustible) tobacco use and decreased rates of smoking cessation.[43,44]

Tobacco promotion is an important cause of tobacco use initiation and escalation among youth.[40] Although television and radio advertising of tobacco have been prohibited in the United States since 1971, electronic nicotine delivery systems are now being aggressively promoted on broadcast media.[45] Tobacco products continue to be advertised in magazines with a substantial proportion of youth readership.[46,47]

Flavoring agents increase the appeal of tobacco products to youth.[48,49] The tobacco industry is currently exploiting the looser regulation on noncigarette tobacco products to market fruit- and candy-flavored cigars, small cigars, and electronic nicotine delivery systems. Flavoring agents with local anesthetic properties, such as menthol, decrease the natural sensation of harshness of the tobacco smoke and make it easier to inhale the smoke deeply.[50,51]

Multipronged legal and political efforts of the tobacco industry have hampered effective tobacco control efforts.[52] The tobacco industry has vigorously fought efforts to alter the image of their product through political campaign contributions, lobbying, litigation, co-opting media to promote "reasonable doubt" about harms, using funds and influence to bias scientific research and communication, and diverting of resources from effective programs to ineffective ones.[53]

Smoking rates have decreased in response to legislative and regulatory interventions including increasing taxes on tobacco products, restricting youth access to tobacco products, restriction of tobacco advertising, and clean air laws (including in workplaces, bars, restaurants, schools, child care facilities, parks, entertainment venues, and other public facilities) as well as interventions that changed the image of tobacco (such as release of the first Surgeon General's report,[54] the Truth campaign,[55,56] and mass-media and antismoking campaigns).[3]

Effective public policy measures are essential to control the tobacco epidemic and protect children's health. The following are evidence-based policy recommendations that can reduce the incidence and prevalence of tobacco and nicotine

dependence among young people and reduce the harms of involuntary tobacco smoke exposure for children. Additional public policy resources are described in Table 1.

PUBLIC POLICY RECOMMENDATIONS

1. The FDA should regulate all tobacco products to protect the public health.

Recommendation Strength: Strong Recommendation

The FDA is charged with the mission of protecting consumers and enhancing public health by maximizing compliance of FDA-regulated products and minimizing risk associated with those products. The FDA Center for Tobacco Products oversees the implementation of the Family Smoking Prevention and Tobacco Control Act,[57] which was passed to protect the public and create a healthier future for all Americans.[58] Regulations, taxes, and restrictions on the sale and use of tobacco products should apply to all tobacco products. Noncigarette tobacco products should not be exempt from regulations and taxes that apply to cigarettes.

2. Tobacco control should be adequately funded.

Recommendation Strength: Strong Recommendation

Tobacco dependence treatment of tobacco-dependent individuals of all ages should be available. Funding mechanisms should include health insurance coverage, school- and workplace-financed programs, and publicly financed programs. Given the important benefits to society of reducing tobacco dependence, cost should not be a barrier to program participation and access to tobacco dependence treatment medications. Health care payers should provide coverage for tobacco dependence treatment without cost sharing. Telephonic tobacco dependence counseling and treatment (such as 1-800-QUIT-NOW) is effective and should be promoted and fully funded as described in the Centers for Disease Control and Prevention (CDC)'s Best Practices for Comprehensive Tobacco Control Programs.[59] The Best Practices recommendations should be implemented with funding at or near recommended levels. As of 2014, only 2 states (Alaska and North Dakota) funded tobacco control efforts at or near CDC-recommended levels.[60]

Tobacco control research should be considered a high priority and funded accordingly from both government and private sources. Research priorities should include the effects of tobacco and nicotine exposure on children and adolescents starting with in utero exposure and continuing through children's growth and development. Research to improve approaches to adolescent tobacco dependence treatment is urgently needed. Researchers, academic medical institutions, and other health care institutions should not accept funding from the tobacco industry for tobacco control programs or research.[61]

RECOMMENDATIONS FOR PUBLIC POLICY TO PROTECT CHILDREN FROM TOBACCO USE INITIATION

3. Tobacco product advertising and promotion in forms that are accessible to children and youth should be prohibited.

Recommendation Strength: Strong Recommendation

The tobacco industry promotes their product by associating the product with images of glamour, success, individuality, virility, coolness, style, slimness, camaraderie, self-confidence, freedom, independence, pleasure, relaxation, social acceptability, and an escape from daily stresses.[62] These images disguise the true reality of addiction, illness, disability, disfigurement, and premature death that tobacco products cause.

4. Point-of-sale tobacco product advertising and product placement that can be viewed by children should be prohibited.

Recommendation Strength: Strong Recommendation

Point-of-sale tobacco product advertising and product placement that can be viewed by children should be prohibited by state and/or local regulations. Until these restrictions are adopted by governments, business owners should adopt them voluntarily. Point-of-sale advertising increases tobacco initiation and tobacco product use among youth. Tobacco products, advertisements, logos, including vintage advertisements, should not be potentially visible to children or adolescents in or near retail establishments. Tobacco products should be placed out of sight, rather than in displays that can be seen by a child passing by, essentially functioning as point-of-sale advertising to children.[63] Tobacco companies should be prohibited from providing materials or incentives for point-of-sale advertising.

5. Depictions of tobacco products in movies and other media that can be viewed by youth should be restricted.

Recommendation Strength: Strong Recommendation

Depictions of tobacco products, tobacco product use, and images associated with tobacco product brands in movies and video games should be restricted. Movies with depictions of any tobacco product use should be given a minimum of an R rating. Movies, videos, video games, and other entertainment media with depictions of tobacco product use should be preceded by strong messages that tell the truth about the harms of tobacco in a manner that is personally relevant to the target audience. These messages should not be funded or otherwise supported or produced by the tobacco industry. These policies should be put in place

voluntarily by the industry; however, should this not be accomplished voluntarily, local, state, and federal government regulations should be adopted to regulate tobacco promotion in media available to children and youth. Tax subsidies should be eliminated for film and to productions in which characters use tobacco products or tobacco products are otherwise depicted. The tobacco industry should not fund or otherwise support tobacco product placement in any media. Media companies and individuals involved in media production (including Internet and social media) should not accept anything in exchange—either implicitly or explicitly—for display of tobacco products. Celebrities should not use their privileged position to model tobacco product use, including electronic nicotine delivery systems and other existing or emerging tobacco products. Film, video game, or other visual media depicting tobacco use or displaying images of tobacco products should contain a prominently displayed declaration as to the presence or absence of direct or indirect tobacco industry support. There should be no sponsorship of events, such as sporting, cultural, or entertainment events, by the tobacco industry or any tobacco manufacturer, vendor, or brand as this functions as advertising that is accessible to children.

6. **The promotion and sale of electronic nicotine delivery systems to youth should be prohibited.**

Recommendation Strength: Strong Recommendation

The promotion and sale of electronic nicotine delivery systems to youth should be prohibited by federal, state, and local regulations. Prohibitions on promotion should include all media that can be viewed by youth, including broadcast, print, and electronic (Web- or Internet-based) media. Prohibitions on promotion should include prohibitions on sponsorships, such as sports, cultural event, and entertainment sponsorships. Any promotional activities that can be accessed by children and/or adolescents should be considered promoting to children. Electronic nicotine delivery systems should be subject to the same restrictions on advertising and promotion at least as restrictive as that on combustible cigarettes. Until government agencies institute these prohibitions, media companies, entertainment companies, sports teams, and promoters should voluntarily institute these prohibitions.

7. **Tobacco control programs should change the image of tobacco by telling the truth about tobacco.**

Recommendation Strength: Strong Recommendation

Tobacco control programs should change the image of tobacco by telling the truth about tobacco. The tobacco industry should be excluded from development and implementation of tobacco education and control programs. The tobacco industry has a long track record of promoting programs that have been shown to be both ineffective and counterproductive.[62] The tobacco industry has been particularly hostile to programs that tell the truth and threaten the image of their product.

Low-income, lesbian/gay/bisexual/transgender, and American Indian/Alaska Native youth shoulder a substantially greater burden of tobacco and nicotine dependence.[64–66] These communities require dedicated resources and more intensive tobacco control efforts.

Media campaigns are an important part of tobacco control efforts. Messages should be tailored to the target population and result in knowledge, attitude, and behavior change. Media campaigns should have sufficient reach, frequency, and duration to be successful. Messages should elicit strong emotional response, such as personal testimonials, viscerally negative content, and direct confrontation of the tobacco industry's marketing tactics.

Federal legislation should be passed requiring pictorial health warnings that tell the truth about the effects of tobacco. Pictorial health warnings that tell the truth about the effects of tobacco improve awareness and decrease social appeal of smoking in adolescents.[67,68]

8. **Tobacco product prices should be increased to reduce youth tobacco use initiation.**

Recommendation Strength: Strong Recommendation

Tobacco product prices should be increased to reduce youth tobacco use initiation.[69] This can be accomplished by mandating a minimum package size for purchase and through increases in tobacco taxes. These changes can be implemented by federal, state, and local governments. Taxation by one government entity should not restrict or impair the ability of other government entities to impose additional taxes on tobacco products. There should not be loopholes in which some tobacco products are regulated and taxed less stringently than others. Tax rates should escalate with inflation. Free samples of tobacco products, along with coupons, discounts, and rebates should be banned. Internet sales of tobacco products should be banned; Internet sales can be easily accessed by minors and can be used to evade local tobacco control regulations and taxes.[70]

To decrease risk of illicit trade, tobacco taxes should be collected on production. Laws and regulations against illicit trade in tobacco products should be aggressively enforced. By circumventing tobacco taxes and restrictions on tobacco

sales, illicit trade in tobacco products harms children.[70]

9. The minimum age to purchase tobacco should be increased to 21 years.

Recommendation Strength: Strong Recommendation

The minimum age to purchase tobacco should be increased to 21 years. Laws and regulations prohibiting the sale of tobacco to minors should be vigorously enforced. Legislation to increase the minimum age of purchase can be implemented at the state and local government levels. Funding for enforcement activities can be provided from federal, state, or local revenues. Middle and high school students often obtain their first tobacco products from older children.[71] Because the vast majority of people who become tobacco dependent do so before 21 years of age, increasing the minimum age of purchase from 18 to 21 years and enforcing this regulation will protect a larger proportion of the population from becoming tobacco dependent.

Enforcement activities that disrupt the commercial distribution of tobacco to minors are consistently associated with reductions in youth smoking rates.[72]

10. Flavoring agents, including menthol, should be prohibited in all tobacco products.

Recommendation Strength: Strong Recommendation

Flavoring agents, including menthol, cloves, fruit, and candy flavors, should be prohibited in tobacco products. Flavoring agents increase the appeal of tobacco products to youth.[48,49] Tobacco use initiation and progression to dependence are more common with use of the flavored products. Menthol flavoring is particularly hazardous to children. Youth who initiate smoking with a menthol-flavored tobacco product are more likely to progress to dependence and to report higher levels of dependence.[73,74]

RECOMMENDATIONS TO PROTECT CHILDREN FROM TOBACCO SMOKE AND NICOTINE EXPOSURE

11. Comprehensive smoking bans should be enacted.

Recommendation Strength: Strong Recommendation

A comprehensive ban on tobacco product use prevents not only exposure of children to tobacco product emissions but also exposure to modeling of tobacco product use and nicotine consumption behavior. These policies should be put in place by state and local governments, and where governments have failed to enact these policies, business owners should take it upon themselves to implement them in the facilities that they control.

Smoking and use of tobacco products that produce an emission should be prohibited in all workplaces, including bars, restaurants, and health care facilities. Smoking and use of tobacco products that produce an emission should be banned in outdoor areas frequented by children, including sidewalks, recreational and sports facilities, entertainment venues, and parks.

Smoking and use of tobacco products (including those that do not produce an emission) should be prohibited on campuses where children are cared for, educated, work, and play. This includes child care facilities, schools, health care facilities, dormitories, entertainment venues, parks and athletic facilities, shopping, restaurants, and leisure facilities.

Smoke-free homes and smoke-free motor vehicles should be promoted. Smoking in a motor vehicle exposes children to high concentrations of tobacco smoke.[4] Prohibitions on smoking in motor vehicles with children present can be addressed through both educational and legislative interventions. Smoke-free homes can be promoted through public education campaigns.

The ceremonial use of tobacco among American Indian and Alaska Native people should be respected. Traditional ceremonial uses of tobacco do not include smoking cigarettes, the ingestion of smokeless tobacco, the use of electronic nicotine delivery systems, or the use of other commercial tobacco products.

12. Smoking in multi-unit housing should be prohibited.

Recommendation Strength: Strong Recommendation

Regulations prohibiting smoking in multi-unit housing should be adopted by state and local governments. Federal, state, and local housing authorities and owners of multi-unit housing facilities should prohibit smoking in their facilities. Smoking in one unit involuntarily exposes those in nearby units.[5,75,76] Besides protecting the health of the children, prohibitions on smoking protects their investment from damage by tobacco smoke and tobacco smoking caused fires.

13. Prohibitions on smoking and use of tobacco products should include prohibitions on use of electronic nicotine delivery systems.

Recommendation Strength: Strong Recommendation

The vapor emitted from electronic nicotine delivery systems contains toxic and carcinogenic substances in addition to nicotine. Use of these products involuntarily exposes others to these hazardous substances.[77,78]

RECOMMENDATIONS TO PROTECT CHILDREN FROM ACUTE NICOTINE POISONING

14. Children younger than 18 years should be legally prohibited from working on tobacco farms and in tobacco production.

Recommendation Strength: Recommendation

State and local governments should prohibit children under 18 years from working on tobacco farms or in tobacco production. Tobacco producers should not employ children under 18 years. Companies that produce and market tobacco products should not obtain supply from tobacco growers that allow children under 18 years to work in tobacco production. Nicotine poisoning, referred to as "green tobacco sickness" is a unique hazard of tobacco farming. It is caused by contact with leaves of the tobacco plant leading to dermal nicotine absorption. The quantity of nicotine absorbed can be enough to cause severe symptoms including weakness, headache, nausea, vomiting, dizziness, abdominal cramps, breathing difficulty, pallor, diarrhea, chills, fluctuations in blood pressure or heart rate, increased perspiration, excessive salivation, and seizures.[79] There have been multiple reports of severe green tobacco sickness in children.[80]

15. Concentrated nicotine solution for electronic nicotine delivery systems should be sold in child-resistant containers with amounts limited to that which would not be lethal to a young child if ingested.

Recommendation Strength: Strong Recommendation

Federal, state, and local governments should require that concentrated nicotine solutions for use by consumers in electronic nicotine delivery systems be packaged in child-resistant containers with amounts limited to that which would not be lethal to a young child if ingested. Until such time as these regulatory requirements are put in place, manufactures and vendors should voluntarily comply with this recommendation. One child has died of the ingestion of nicotine-containing electronic nicotine delivery systems solution.[81]

CONCLUSIONS

Tobacco is unique among consumer products in that it severely injures and kills when used exactly as intended. Children are harmed from tobacco product use and tobacco smoke exposure. Protecting children from tobacco products is one of the most important things that a society can do to protect children's health. Effective public policy interventions to reduce the incidence of tobacco and nicotine dependence among children and to reduce children's tobacco smoke exposure have been documented. It is imperative that policy makers at the international, national, state, and local levels allocate resources and take action.

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ABBREVIATIONS

CDC: Centers for Disease Control and Prevention
FDA: US Food and Drug Administration

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Public Policy to Protect Children From Tobacco, Nicotine, and Tobacco Smoke

SECTION ON TOBACCO CONTROL

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TECHNICAL REPORT

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

Protecting Children From Tobacco, Nicotine, and Tobacco Smoke

Harold J. Farber, MD, MSPH, FAAP, Judith Groner, MD, FAAP, Susan Walley, MD, FAAP, Kevin Nelson, MD, PhD, FAAP, SECTION ON TOBACCO CONTROL

abstract

This technical report serves to provide the evidence base for the American Academy of Pediatrics' policy statements "Clinical Practice Policy to Protect Children From Tobacco, Nicotine, and Tobacco Smoke" and "Public Policy to Protect Children From Tobacco, Nicotine, and Tobacco Smoke." Tobacco use and involuntary exposure are major preventable causes of morbidity and premature mortality in adults and children. Tobacco dependence almost always starts in childhood or adolescence. Electronic nicotine delivery systems are rapidly gaining popularity among youth, and their significant harms are being documented. In utero tobacco smoke exposure, in addition to increasing the risk of preterm birth, low birth weight, stillbirth, placental abruption, and sudden infant death, has been found to increase the risk of obesity and neurodevelopmental disorders. Actions by pediatricians can help to reduce children's risk of developing tobacco dependence and reduce children's involuntary tobacco smoke exposure. Public policy actions to protect children from tobacco are essential to reduce the toll that the tobacco epidemic takes on our children.

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INTRODUCTION

This technical report describes the evidence base for the American Academy of Pediatrics' policy statements "Public Policy to Protect Children From Tobacco, Nicotine, and Tobacco Smoke" and "Clinical Practice Policy to Protect Children From Tobacco, Nicotine, and Tobacco Smoke".[1,2]

The goal of the present technical report is to document knowledge regarding the harms of tobacco to children and adolescents and to document the evidence for actions by clinicians and policy makers to reduce the toll that tobacco takes on children and adolescents. Because comprehensive literature reviews and evaluations are conducted by the Office of the Surgeon General, the present report focused on additional research findings subsequent to the Reports of the Surgeon General and topics not well covered in those reports. When multiple studies produced similar findings, the best quality and/or most recent are presented with reference to meta-analyses or authoritative statements (eg, Reports of the

Surgeon General, US Public Health Service recommendations or guidelines) when available. Relevant literature was identified by using PubMed searches and references cited in relevant review articles or authoritative statements. Each article was assessed for quality and relevance. Reports of the Surgeon General were identified from the Web site http://www.surgeongeneral.gov/library/reports/index.html.

GRADING EVIDENCE ON THE HARMS OF TOBACCO

Because it is unethical to conduct randomized controlled clinical trials among children with a substance that is harmful, the evidence related to the harms of tobacco has been graded as follows: strong quality—consistent findings from double-blind, randomized controlled clinical trials, large representative-sample epidemiologic studies, good-quality meta-analyses incorporating large representative studies with consistent results, and/or a Report of the Surgeon General of a "major conclusion" or "evidence is sufficient"; good quality—well-performed, generalizable case-control study, other well-performed epidemiologic study, other meta-analyses, and a Report of the Surgeon General of "evidence is suggestive"; or fair quality—other research study, small sample size, and findings not replicated.

GRADING EVIDENCE FOR CLINICAL AND POLICY RECOMMENDATIONS

Evidence quality and strength of recommendations were determined on the basis of guidelines of the American Academy of Pediatrics' policy statement "Classifying Recommendations for Clinical Practice Guidelines" and are summarized in Fig 1 and Table 1.[3]

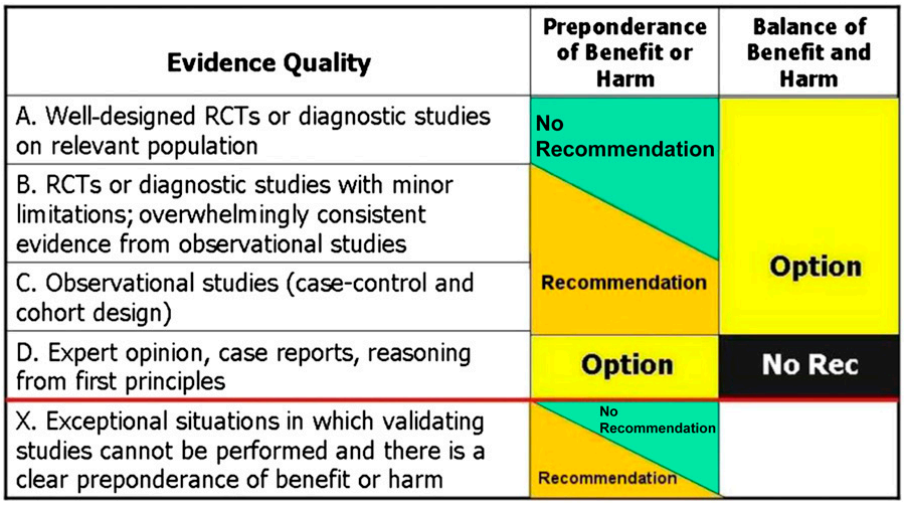

FIGURE 1
Evidence quality. RCT, randomized controlled trial.

DEFINITIONS

- Tobacco product: any nicotine delivery product, currently regulated or unregulated by the US Food and Drug Administration (FDA), which is not approved for safe and effective tobacco dependence treatment.
- Secondhand smoke: the smoke emitted from a tobacco product that is inhaled by a nonuser.
- Thirdhand smoke: the tobacco smoke that is absorbed onto surfaces and exposes the nonuser by either direct contact and dermal absorption and/or off-gassing and inhalation. Thirdhand smoke may react with oxidants and other compounds in the environment to yield secondary pollutants.[4]
- Involuntary tobacco smoke exposure: the tobacco smoke exposure of nonusers. Involuntary exposure includes both secondhand and thirdhand exposure.
- Electronic nicotine delivery systems: handheld devices that produce an aerosol from a solution typically containing nicotine, flavoring chemicals, and carrier solvents such as propylene glycol and vegetable glycerin (glycerol) for inhalation by the user. Alternate names for these products include electronic cigarettes, e-cigarettes, e-cigs, electronic cigars, e-cigars, electronic hookah, e-hookah, hookah sticks, personal vaporizers, mechanical mods, vape pens, and vaping devices.

KEY FINDINGS

How Tobacco Harms Children

1. *Tobacco product use is common among youth.* Quality of evidence: strong
2. *More than one-half of children in the United States have evidence of tobacco smoke exposure.* Quality of evidence: strong
3. *Tobacco dependence creates a substantial economic burden for both civilian and military sectors.* Quality of evidence: strong
4. *Tobacco kills people when used as intended.* Quality of evidence: strong
5. *Tobacco smoke exposure harms children.* Quality of evidence: strong
6. *Tobacco exposure harms the fetus.* Quality of evidence: strong
7. *Tobacco increases infant mortality.* Quality of evidence: strong
8. *Tobacco smoke exposure increases asthma prevalence and severity.* Quality of evidence: strong
9. *The effects of tobacco smoke exposure on risk of asthma start in utero.* Quality of evidence: strong

TABLE 1 Guideline Definitions for Evidence-Based Statements

Statement	Definition	Implication
Strong recommendation	A strong recommendation in favor of a particular action is made when the anticipated benefits of the recommended intervention clearly exceed the harms (as a strong recommendation against an action is made when the anticipated harms clearly exceed the benefits) and the quality of the supporting evidence is excellent. In some clearly identified circumstances, strong recommendations may be made when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms	Clinicians and policy makers should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present
Recommendation	A recommendation in favor of a particular action is made when the anticipated benefits exceed the harms, but the quality of evidence is not as strong. Again, in some clearly identified circumstances, recommendations may be made when high-quality evidence is impossible to obtain but the anticipated benefits outweigh the harms	Clinicians and policy makers would be prudent to follow a recommendation but should remain alert to new information and sensitive to patient preferences
Option	Options define courses that may be taken when either the quality of evidence is suspect or carefully performed studies have shown little clear advantage to one approach over another	Clinicians and policy makers should consider the option in their decision-making, and preference may play a substantial role
No recommendation	No recommendation indicates that there is a lack of pertinent published evidence and that the anticipated balance of benefits and harms is presently unclear	Clinicians and policy makers should be alert to new published evidence that clarifies the balance of benefit versus harm

10. *Tobacco smoke exposure increases the severity of bronchiolitis.* Quality of evidence: strong
11. *Tobacco smoke exposure increases risk for and severity of other respiratory illnesses.* Quality of evidence: strong
12. *Tobacco smoke exposure increases the risk of middle ear disease.* Quality of evidence: strong
13. *In utero tobacco smoke exposure increases the risk of being overweight in childhood.* Quality of evidence: strong
14. *Tobacco smoke exposure increases the risk of learning and neurobehavioral problems.* Quality of evidence: strong
15. *Tobacco smoke exposure of children leads to findings of preclinical atherosclerosis.* Quality of evidence: strong
16. *Tobacco smoke exposure increases the risk of childhood cancers.* Quality of evidence: good
17. *Smoke-free homes may reduce children's tobacco smoke exposure.* Quality of evidence: good
18. *Tobacco dependence almost always develops before reaching the age of majority.* Quality of evidence: strong
19. *Tobacco dependence is a treatable chronic illness.* Quality of evidence: strong

Recommended Actions for Pediatricians

1. *Inquire about tobacco use and tobacco smoke exposure as part of health supervision visits and visits for diseases that may be caused or exacerbated by tobacco smoke exposure.* Evidence quality: B; Recommendation strength: strong recommendation
2. *Include tobacco use prevention as part of anticipatory guidance.* Evidence quality: B; Recommendation strength: strong recommendation
3. *Address parent/caregiver tobacco dependence as part of pediatric health care.* Evidence quality: B; Recommendation strength: strong recommendation
   - 3a. *Recommend tobacco dependence treatment of tobacco-dependent parents and caregivers.* Evidence quality: B; Recommendation strength: strong recommendation
   - 3b. *Implement systems to identify and offer counseling, treatment, treatment recommendations, and/or referral for tobacco-dependent parents.* Evidence quality: C; Recommendation strength: recommendation
4. *Offer tobacco dependence treatment and/or referral to adolescents who want to stop smoking.* Evidence Quality: B; Recommendation strength: strong recommendation
   - 4a. *Tobacco dependence pharmacotherapy can be considered for moderate to severely tobacco-dependent adolescents who want to stop smoking*. Evidence quality: D; Recommendation strength: option
5. *Offer tobacco-dependent individuals quitline referral.* Evidence quality: A; Recommendation strength: strong recommendation
6. *Consider potential for neuropsychiatric symptoms with tobacco dependence treatment.* Evidence quality: C; Recommendation strength: recommendation

7. *Do not recommend electronic nicotine delivery systems for tobacco dependence treatment.* Evidence quality: B; Recommendation strength: strong recommendation
8. *If the sources of a child's tobacco smoke exposure cannot be eliminated, provide counseling about strategies to reduce the child's tobacco smoke exposure.* Evidence quality: C, Recommendation strength: recommendation

Public Policy Recommendations

1. *The FDA should regulate all tobacco products to protect the public health.* Evidence quality: X; Recommendation strength: strong recommendation
2. *Tobacco control should be adequately funded.* Evidence quality: A; Recommendation strength: strong recommendation

Recommendations for Public Policy to Protect Children From Tobacco Use Initiation

3. *Tobacco product advertising and promotion in forms that are accessible to children and youth should be prohibited.* Evidence quality: B; Recommendation strength: strong recommendation
4. *Point-of-sale tobacco product advertising and product placement that can be viewed by children should be prohibited.* Evidence quality: B; Recommendation strength: strong recommendation
5. *Depictions of tobacco products in movies and other media that can be viewed by youth should be restricted.* Evidence quality: B; Recommendation strength: strong recommendation
6. *The promotion and sale of electronic nicotine delivery systems to youth should be prohibited.* Evidence quality: B; Recommendation strength: strong recommendation
7. *Tobacco control programs should change the image of tobacco by telling the truth about tobacco.* Evidence quality: B; Recommendation strength: strong recommendation
8. *Tobacco product prices should be increased to reduce youth tobacco use initiation.* Evidence quality: B; Recommendation strength: strong recommendation
9. *The minimum age to purchase tobacco should be increased to 21 years.* Evidence quality: B; Recommendation strength: strong recommendation
10. *Flavoring agents, including menthol, should be prohibited in all tobacco products.* Evidence quality: B; Recommendation strength: strong recommendation

Recommendations to Protect Children From Tobacco Smoke and Nicotine Exposure

11. *Comprehensive smoking bans should be enacted.* Evidence quality: B; Recommendation strength: strong recommendation
12. *Smoking in multi-unit housing should be prohibited.* Evidence quality: B; Recommendation strength: strong recommendation
13. *Prohibitions on smoking and use of tobacco products should include prohibitions on use of electronic nicotine delivery systems.* Evidence quality: B; Recommendation strength: strong recommendation

Recommendations to Protect Children From Acute Nicotine Poisoning

14. *Children younger than 18 years should be legally prohibited from working on tobacco farms and in tobacco production.* Evidence quality: C, Recommendation strength: recommendation
15. *Concentrated nicotine solution for electronic nicotine delivery systems should be sold in child-resistant containers with amounts limited to that which would not be lethal to a young child if ingested.* Evidence quality: B, Recommendation strength: strong recommendation

HOW TOBACCO HARMS CHILDREN

1. Tobacco product use is common among youth.

Quality of evidence: strong

The 2012 Report of the Surgeon General concluded, "Almost one in four high school seniors is a current (in the past 30 days) cigarette smoker, compared with one in three young adults and one in five adults." Approximately 1 in 10 high school senior male students is a current smokeless tobacco user, and ~1 in 5 high school senior male students is a current cigar smoker. Significant disparities in tobacco use remain among young people nationwide. In the United States, the prevalence of cigarette smoking is highest among American-Indian and Alaska Native people compared with other ethnic groups and highest among youth of lower socioeconomic status compared with more affluent youth. The use of smokeless tobacco is increasing among self-identified white male high school students, and cigar smoking may be increasing among black female high school students.[4]

Table 2 describes the different forms of tobacco currently available in the United States. The 2012 US National Youth Tobacco Survey (NYTS) described 6.7% of middle school students (5.6% of girls and 7.8% of boys) as currently (ie, within the last 30 days) using any tobacco products, with cigarettes (3.1%), cigars (2.8%), smokeless tobacco (1.7%), pipes (1.8%), hookahs (water pipes) (1.3%), electronic cigarettes (e-cigarettes) (1.1%), and Swedish snuff (snus) (0.8%) as the most commonly used products. Among high school students, 23.3% (18% of girls and 28% of boys) reported current (ie, within the last 30 days) use of any tobacco product, with cigarettes (14.0%), cigars (12.6%), smokeless tobacco (6.4%), pipes (4.5%), hookahs (5.4%), e-cigarettes

TABLE 2 Tobacco Products Currently Available in the United States

Product	Description	Comments
Cigarettes	A small roll of paper that is filled with cut tobacco and smoked	Cigarettes are still the most common form of tobacco used by youth
Cigars and little cigars	A tightly-rolled bundle of dried and fermented tobacco, wrapped in a tobacco leaf. Cigars come in a variety of flavors, including "cherry," "peach," and "grape"	In the United States, cigars are exempt from many of the marketing regulations that govern cigarettes, and cigars are taxed at a far lower rate than cigarettes. Flavors and lower cost appeal to children. Little cigars are similar to regular cigarettes, except wrapping is tobacco leaf rather than paper
Pipes	A tube with a small bowl at one end; used for smoking tobacco	Pipes use black (air-cured) tobacco, which carries a higher risk of esophageal cancer
Hookahs or narghile	A single or multi-stemmed instrument for smoking in which the smoke is cooled by passing through water	Longer duration of a smoking session and deeper inhalation leads to much higher smoke intake than cigarette smoking
Bidis (or beedis)	A thin, South Asian cigarette filled with tobacco flake and wrapped in a tendu leaf tied with a string at 1 end	Bidis must be puffed more rapidly than regular cigarettes to remain lit. Bidis contain more tar, nicotine, and carbon monoxide than the typical cigarette
Kreteks	Cigarettes made with a blend of tobacco, cloves, and other flavors. The word "kretek" is an onomatopoetic term for the crackling sound of burning cloves	Cloves contain eugenol, whose local anesthetic effect allows deeper inhalation
Chewing tobacco	Loose leaves, plugs, or twists of tobacco that are placed between the cheek and gum	
Snuff	Finely ground tobacco packaged in cans or pouches, which can be sold dry (powdered form that is sniffed) or moist (placed between the lower lip or cheek and gum)	
Snus	A moist powder tobacco product originating from a variant of dry snuff. It is usually not fermented	
Dissolvable tobacco	Unlike ordinary chewing tobacco, it dissolves in the mouth. Orbs or pellets look similar to small breath mints. Sticks similar to toothpicks are for insertion between the upper lip and gum. Strips administer nicotine by using thin-film drug delivery technology and look similar to breath-freshening strips	Discreet form, candy-like appearance, and added flavorings make them attractive to young children
Electronic nicotine delivery systems, electronic cigarettes, e-cigarettes, e-cigs, hookah sticks, e-hookahs, e-cigars, e-pipes, mechanical mods, vape pens, others	Battery-powered devices heat a solution to create an aerosol. Devices usually contain nicotine, propylene glycol, and flavoring agents. There is no regulation on contents or manufacturing standards. Heating the mixture creates other toxins.	Flavors and promotion increase appeal to youth

(2.8%), and snus (2.5%) as the most commonly used products.[5] Concurrent use of multiple tobacco products is common. In the 2012 NYTS, 9.9% of US high school students reported use of 2 or more different tobacco products.[6]

Analyses of data from the 2011 and 2012 NYTS found that initiation rates for e-cigarette use doubled from 1.4% to 2.7% among middle school students and from 4.7% to 10.0% among high school students. Current (ie, within the last 30 days) e-cigarette use showed a similar pattern, with increases from 0.6% to 1.1% of middle school students and 1.5% to 2.8% of high school students in the 2011–2012 period.[7] Current data show that rates of e-cigarette use are dramatically escalating among youth, with the 2014 NYTS reporting current (ie, within the last 30 days) e-cigarette use in 3.9% of middle school students and 13.4% of high school students, increases of 650% and 890%, respectively, compared with 2011 data.[8] The Monitoring the Future survey reported current (ie, within the last 30 days) e-cigarette use among 16.2% of 11th graders and 17.1% of 12th graders in 2014.[9] Hookah use among youth is also rapidly escalating, with 9.4% of high school students reporting hookah use according to the 2014 NYTS.[8]

Analysis of data from the Growing Up Today Study, a large, longitudinal cohort of adolescents followed up from ages 12 to 24 years (N = 13 913), found smoking initiation at younger ages and greater prevalence of smoking and amount smoked among homosexual and bisexual youth. Odds of past-month smoking were 1.66 (95% confidence interval [CI]: 1.22–2.28) and 1.57 (95% CI: 1.28–1.94) for bisexual and gay male subjects, respectively, and 2.62 (95% CI: 2.31–2.97) and 2.12 (95% CI: 1.70–2.64) for bisexual and gay female subjects relative to heterosexual youth.[10]

2. More than one-half of children in the United States have evidence of tobacco smoke exposure.

Quality of evidence: strong

The National Health and Nutrition Examination Survey (NHANES) assesses a nationally representative sample of the noninstitutionalized US civilian population. Tobacco smoke exposure is indicated by a measurable serum cotinine concentration. Cotinine, a nicotine metabolite, is a biomarker of recent tobacco exposure and can be measured in serum, urine, and saliva.[11] In the 2007–2008 NHANES, 53.6% (95% CI: 46.2–61.0) of children 3 to 11 years of age had evidence of tobacco smoke exposure. This amount is greater than the level of exposure in adults aged 20 years or older, among whom 36.7% (95% CI: 32.0–41.3) were exposed. The 2007–2008 survey results were similar to findings of the 2001–2002 and 2005–2006 surveys and showed slightly less exposure than the 1999–2000 and 2003–2004 surveys.[12]

Tobacco-dependent parents and caregivers are important sources of children's tobacco smoke exposure. A total of 519 children aged 3 to 12 years with a history of asthma and tobacco smoke exposure were enrolled in a clinical trial of an intervention for reducing tobacco smoke exposure.[13] The ratio of urine cotinine to creatinine was higher if either the mother or caregiver were tobacco smokers and highest if both were smokers.

3. Tobacco dependence creates a substantial economic burden for both civilian and military sectors.

Quality of evidence: strong

Using rigorous methods, the 2014 Report of the Surgeon General determined that smoking-attributable economic costs were $289 to $332.5 billion per year in the United States.[14] These costs include $132.5 to $175.9 billion for direct medical care of adults, $151 billion for lost productivity because of premature death, and $5.6 billion from lost productivity because of exposure to secondhand smoke.

Tobacco use leads to a substantial burden for the armed services. A 2009 Institute of Medicine report quotes the US Department of Defense Assistant Secretary of Defense for Health Affairs, "Every year, tobacco use leads to unnecessary compromises in the readiness of our troops and costs the Department of Defense millions of dollars in preventable health care costs." Tobacco use can impair troops both through the effects of tobacco smoke toxicants, including carbon monoxide, and through nicotine withdrawal. Analyses of data from TRICARE (the health care program serving US uniformed service members, retirees, and their families) identified excess medical costs of approximately $228 per tobacco user per year, with retirees and dependents incurring greater medical costs because of tobacco use ($321) than active-duty enrollees ($104) or their dependents ($106). Tobacco use in the military is also associated with failure to complete basic training and premature discharge from the armed forces.[15–17]

4. Tobacco kills people when used as intended.

Quality of evidence: strong

Tobacco use by youth and young adults has severe adverse health consequences. This evidence has been summarized in multiple Reports of the Surgeon General from 1964 onward.[4,14,18–20] The landmark 40-year prospective follow-up study of 34 439 male British physicians by Doll et al[21] found that nearly one-half of all regular cigarette smokers died as a result of their addiction. The age at which one-half of subjects had died was 8 years younger for smokers than for nonsmokers. The risk of smoking-related disease was reduced by stopping smoking. Similar results were found in a 25-year follow-up study of 49 539 Norwegian adults.[22] The same Norwegian study found a synergistic effect of smoking and obesity on mortality in middle age, with the combination of heavy smoking and obesity leading to much greater premature mortality than either factor alone.[23] A study in Finland comparing changes in smoking rates with changes in lung cancer rates 20 years later found a correlation close to 1:1 (R^2 = 0.95).[24]

5. Tobacco smoke exposure harms children.

Quality of evidence: strong

The substantial harm of tobacco toxin exposure for children has been extensively documented, with evidence summarized in the 2006 Report of the Surgeon General.[25] Because nicotine and other tobacco toxins cross the placenta, children are harmed from exposure to tobacco toxins starting in utero. This exposure can be both from the mother's tobacco product use as well as her exposure (via inhalation or absorption) to the tobacco smoke of others. Children are harmed from secondhand tobacco smoke exposure by breathing in the smoke emitted by others who are using combustible tobacco products.

Thirdhand tobacco smoke exposure is increasingly being recognized as another route of tobacco toxin exposure.[26] Thirdhand tobacco smoke is the smoke that remains on surfaces and in dust, which may be re-emitted into the gas phase or may react with oxidants and other compounds in the environment to yield secondary pollutants.[27] Thirdhand smoke includes nicotine, tobacco-specific carcinogens, and other toxicants.[28,29] Children can absorb, ingest, and inhale these substances. An analysis of house dust samples collected from private homes of tobacco smokers in northeastern Spain found tobacco-related

carcinogens in the dust at levels sufficient to increase the risk of cancer.[30] Young children may have greater exposure because toddlers commonly explore by placing objects in the mouth. Children and adolescents can also be harmed from absorption of tobacco toxins when they participate in tobacco production.[31,32]

6. Tobacco exposure harms the fetus.

Quality of evidence: strong.

The 2014 Report of the Surgeon General found that the evidence is sufficient to conclude that tobacco smoking in early pregnancy causes orofacial clefts.[14]

In utero tobacco exposure from either maternal active tobacco product use or maternal secondhand tobacco smoke exposure increases the risk of stillbirth. The Missouri maternally linked cohort data set contains information on both live births and fetal deaths, with maternal smoking during pregnancy routinely documented on the birth certificate on the basis of the mother's response after delivery.[33] The large data set included 57 965 stillbirth cases and 51 436 413 live birth controls. There was a dose–response relationship, with greater risk of stillbirth relating directly to the amount the mother smoked. For deliveries at 20+ weeks' gestation, the risk of stillbirth was increased compared with nonsmokers, with an odds ratio (OR) of 1.43 (95% CI: 1.31–1.57) if the mother smoked >1 pack per day and an OR of 1.31 (95% CI: 1.22–1.41) if the mother smoked one-half to 1 pack per day. A study using data from the Swedish Medical Birth Register (with 2322 stillbirths and 851 371 live births) found that, compared with mothers who did not use tobacco, the risk of stillbirth increased for mothers who were tobacco smokers (adjusted OR: 1.59 [95% CI: 1.40–1.80]) and snus users (adjusted OR: 1.43 [95% CI: 1.02–1.99]).[34] A study of 1110 pregnant women in Mumbai, India, found a substantial increased risk of stillbirth associated with maternal use of smokeless tobacco (OR: 2.6 [95% CI: 1.4–4.8])[35] and if the mother did not smoke but was exposed to the smoke of another inside the home.[36] A study in Newfoundland, Canada, of 11 862 nonsmoking women with singleton gestations, of whom 11.1% reported exposure to secondhand tobacco smoke, found an increased risk of stillbirth with an adjusted OR of 3.35 (95% CI: 1.16–9.72).[37] A recent meta-analysis found that maternal exposure to secondhand tobacco smoke during pregnancy increased the risk of stillbirth (OR: 1.23 [95% CI: 1.09–1.38]).[38]

Maternal smoking also increases the risk of placenta-associated complications of pregnancy. A case-control study in Finland compared 175 placental abruption case subjects with 370 delivery time–matched control subjects.[39] There were more smokers among case subjects (27.4% vs 14.3%; $P < .001$). Serum cotinine concentrations were greater in case subjects compared with control subjects (median: 229.5 vs 153.5 ng/mL; $P = .002$), and many more case subjects than control subjects had serum cotinine concentrations >15 ng/dL (30.3% vs 17.6%; $P < .001$). These findings provide biological confirmation of the greater tobacco exposure in case subjects compared with control subjects. An analysis of data from the Missouri Electronic Vital Records system of 1 312 505 singleton births at 20 to 44 weeks' gestation found that if the mother was a smoker, the risk of placental abruption and placenta previa were substantially greater (0.71% vs 1.27% [$P < .01$] and 0.35% vs 0.48% [$P < .01$], respectively). A dose–response relationship was observed; the ORs for placental abruption and placenta previa were greater for those who smoked ≥20 cigarettes per day compared with those who smoked 0 to 9 cigarettes per day (OR compared with nonsmokers: 1.9 [95% CI: 1.7–2.0] and 1.7 [95% CI: 1.1–1.9] vs 1.5 [95% CI: 1.4–1.7] and 1.4 [95% CI: 1.2–1.5]).[40]

Both active maternal smoking and secondhand maternal tobacco smoke exposure have been shown to reduce birth weight. A case-control study in Saudi Arabia compared birth outcomes of 1085 tobacco smoke–exposed women with those of 2341 unexposed women with term, singleton pregnancies. Mean birth weight was lower in the tobacco smoke–exposed women compared with the unexposed women (3.15 vs 3.21 kg; $P = .002$).[41] In Rhode Island, a longitudinal follow-up study of 119 pregnant women enrolled in their third trimester of pregnancy found that birth weight was greater for nonsmoking women and women who stopped smoking during pregnancy compared with those who continued to smoke (mean birth weight: 3.46 and 3.56 kg vs 3.16 kg, respectively; $P = .004$).[42] When biomarkers of tobacco exposure in the infant's meconium were assayed, findings were similar, with greater mean birth weight if biomarkers of tobacco exposure were absent versus if those biomarkers were present (3.50 vs 3.20 kg; $P < .001$). A case-control study in Lucknow, India, of mothers aged 20 to 30 years who did not use tobacco compared those who had a low birth weight infant (<2.5 kg) versus those who did not have a low birth weight infant (≥2.5 kg).[43] After adjusting for other factors associated with low birth weight, a history of tobacco smoke exposure (ie, active smoker in the home smoked in their presence) increased the odds for low birth weight (adjusted OR: 3.16 [95% CI: 1.9–5.3]). Similar findings were noted in a retrospective cohort study in Newfoundland, Canada, of nonsmoking women with singleton gestations.[37] A total of 1202 women with a history of tobacco smoke exposure were compared with 10 650 women with no tobacco

smoke exposure. Mean birth weight was lower for the smoke-exposed women (3.43 vs 3.51 kg; $P < .0001$), and the odds of low birth weight (<2.5 kg) were also greater for the smoke-exposed women (OR: 1.65 [95% CI: 1.29–2.09]).

Maternal smoking and tobacco smoke exposure increase the risk of preterm birth. A birth cohort study of 10 095 nonsmoking women aged >18 years who had a singleton live birth in Lanzhou, China, found that maternal tobacco smoke exposure was associated with an increased risk of very preterm (<32 weeks' gestation) birth, with a dose–response relationship demonstrated.[44] For those exposed to smoke for <1 hour per day, the OR for a very preterm birth was 1.89 (95% CI: 1.26–2.84), and for those exposed to ≥1 hour per day, the OR for a very preterm birth was 2.61 (95% CI: 1.56–4.34) compared with mothers who were not exposed to smoke. An analysis of data from the Swedish Medical Birth Register found that the risk of preterm birth was increased for both maternal snus use (adjusted OR: 1.27 [95% CI: 1.14–1.41]) and maternal smoking at 1 to 9 cigarettes per day and ≥10 cigarettes per day (adjusted OR: 1.24 [95% CI: 1.17–1.32] and 1.56 [95% CI: 1.44–1.69], respectively).[45] Analysis of data from the Generation R study, a longitudinal follow-up study from early pregnancy onward of 9778 mothers and their children living in Rotterdam, the Netherlands, found that continued maternal smoking after pregnancy was associated with low birth weight (adjusted OR: 1.75 [95% CI: 1.20–2.56]) and preterm birth (adjusted OR: 1.36 [95% CI: 1.04–1.78]) in the fully adjusted models.[46] An ecologic study in Belgium found that after introduction of staged smoke-free legislation (first workplaces, then restaurants, then bars that serve food), rates of preterm birth decreased, with further decreases in preterm birth rates with each successive escalation of the smoking restrictions.[47] Similar reductions in preterm birth were observed coinciding with the implementation of smoke-free legislation in Scotland.[48]

7. Tobacco increases infant mortality.

Quality of evidence: strong

Using 2005–2009 data, the 2014 Report of the Surgeon General determined that tobacco smoking during pregnancy results in nearly 1000 infant deaths per year or ~8% of all infant deaths and 17% of all cases of sudden infant death syndrome (SIDS).[14]

Tobacco smoke exposure increases an infant's risk of SIDS. This conclusion was a major finding of the 2006 Report of the Surgeon General.[25] Both prenatal and postnatal exposure contributes to the risk. Association of in utero tobacco smoke exposure with abnormalities of sleep arousal responses has been demonstrated.[49–51] A recent Dutch case-control study compared 142 SIDS case subjects versus 2841 control subjects recruited from well-infant clinics. The study found that, compared with nonsmoking parents, parental smoking led to an increased risk of SIDS, with the risk greater if both parents were smokers (OR: 5.8 [95% CI: 2.2–15.5]) versus if 1 parent was a smoker (OR: 2.5 [95% CI: 1.2–5.0]), thus demonstrating a dose–response effect.[52]

8. Tobacco smoke exposure increases asthma prevalence and severity.

Quality of evidence: strong

Tobacco smoke exposure increases the risk of asthma, wheezing, and asthma exacerbations in children. The 2006 Report of the Surgeon General concluded, "The evidence is sufficient to infer a causal relationship between parental smoking and cough, phlegm, wheeze, and breathlessness among children of school age. The evidence is sufficient to infer a causal relationship between parental smoking and ever having asthma among children of school age. The evidence is sufficient to infer a causal relationship between secondhand smoke exposure from parental smoking and the onset of wheeze illnesses in early childhood."[25] The Bogalusa Heart Study showed that asthma prevalence was consistently greater in children whose mothers were smokers, with nearly 3000 children surveyed on 3 occasions between 1983 and 1994; ORs ranged from 1.35 (95% CI: 1.01–1.81) to 1.51 (95% CI: 1.17–1.96) depending on survey year.[53] Among children aged 1 to 16 years hospitalized for asthma, having detectable salivary cotinine levels was associated with increased odds of readmission within 12 months (adjusted OR: 2.35 [95% CI: 1.22–4.55]).[54] Among 466 children enrolled in the CHIRAH (Chicago Initiative to Raise Asthma Health Equity) study, increases in salivary cotinine concentrations were associated with an increased risk of asthma exacerbations.[55] Implementation of smoke-free legislation led to decreases in childhood asthma hospitalizations in England and Scotland.[56,57]

9. The effects of tobacco smoke exposure on risk of asthma start in utero.

Quality of evidence: strong

Prenatal tobacco smoke exposure adversely affects lung development. In a cohort of 4574 mothers and their children prospectively followed up from pregnancy through the first 4 years of the child's life, exposure to maternal smoking when in utero as well as secondhand smoke after birth were associated with increased risk for wheezing at 2 to 4 years of age.[58] History of in utero tobacco smoke exposure was associated with greater rates of poor asthma control in 2481 Latino and African-American children with asthma when assessed at 8 to 17 years of age.[59] A prospective follow-up study of 1129 children from birth

to 14 years of age found that maternal smoking during pregnancy was associated with current asthma, current wheeze, and exercise-induced wheeze (ORs: 1.84 [95% CI: 1.16–2.92], 1.77 [95% CI: 1.14–2.75], and 2.29 [95% CI: 1.37–3.85], respectively).[60] Analyses of data from the CAMP (Childhood Asthma Management Program) study found that a history of in utero tobacco smoke exposure markedly attenuated the benefit of inhaled corticosteroid response among children aged 5 to 12 years with persistent asthma and demonstrated airway hyperreactivity.[61] A meta-analysis of 79 prospective epidemiologic studies published between 1997 and February 2011 assessed the association between tobacco smoke exposure and the incidence of wheeze or asthma in childhood; it found that prenatal maternal smoking and household secondhand tobacco smoke exposure were associated with an increased risk of asthma.[62]

10. Tobacco smoke exposure increases the severity of bronchiolitis.

Quality of evidence: strong

In utero and secondhand tobacco smoke exposure of children leads to more severe episodes of bronchiolitis. The 2006 Report of the Surgeon General concluded, "Smoking by parents causes respiratory symptoms and slows lung growth in their children." It also concluded, "The evidence is sufficient to infer a causal relationship between secondhand smoke exposure from parental smoking and lower respiratory tract illnesses in infants and children."[25] The increased risk of lower respiratory illnesses is greatest from smoking by the mother. A study in Liverpool, United Kingdom, of 378 infants hospitalized for bronchiolitis, of whom 299 (79%) had respiratory syncytial virus (RSV) infection, found that having a household tobacco smoker increased the odds of needing supplemental oxygen and needing mechanical ventilation during the hospitalization (ORs: 2.45 [95% CI: 1.60–3.74] and 5.49 [95% CI: 2.78–10.83], respectively).[63] A case-control study of infants born at 32 to 35 weeks' gestation found that smoking in the presence of the child and maternal smoking during pregnancy were more common in the cases with RSV hospitalization (ORs: 1.59 [95% CI: 1.12–2.26] and 1.62 [95% CI: 1.17–2.24]).[64] According to a prospective follow-up study of 217 healthy newborn infants from a single pediatric center in Denmark, a history of smoking in the household was associated with a higher risk of hospitalization because of RSV in the first year of life (OR: 5.06 [95% CI: 1.36–18.76]).[65] A systematic literature review of studies assessing the effect of tobacco smoke exposure on RSV bronchiolitis in children aged younger than 5 years identified 30 relevant articles published between 1990 and 2009.[66] The review found a consistent impact of tobacco smoke exposure on risk of hospitalizations for RSV disease.

11. Tobacco smoke exposure increases risk for and severity of other respiratory illnesses.

Quality of evidence: strong

Tobacco smoke exposure increases the risk of pneumonia and cough. The 2006 Report of the Surgeon General concluded, "The evidence is sufficient to infer a causal relationship between parental smoking and cough, phlegm, wheeze, and breathlessness among children of school age"; "The evidence is sufficient to infer a causal relationship between maternal smoking during pregnancy and persistent adverse effects on lung function across childhood"; and "The evidence is sufficient to infer a causal relationship between exposure to secondhand smoke after birth and a lower level of lung function during childhood."[25] A population survey in Vietnam of 24 781 households with a child younger than 5 years found that having 1 or more smokers in the household was associated with an increased risk of hospitalization for pneumonia in the previous 12 months (adjusted OR: 1.55 [95% CI: 1.25–1.92]).[67] The Cincinnati Childhood Allergy and Air Pollution Study prospectively followed up children from the newborn period.[68] At 7 years of age, lung function and hair cotinine data were available on 486 members of the cohort. Significant reductions in forced expiratory volume in 1 second (0.03 L, $P < .05$) and mean forced expiratory flow between 25% and 75% of the forced vital capacity (0.06 L/s, $P < .01$) were seen for every log-unit change in cotinine concentration. A survey of 1718 children in third and fourth grades in Guangzhou, China, found increased sneezing and coughing at night among those with tobacco smoke exposure inside the home.[69] A study of 117 children younger than 15 years hospitalized for influenza found that the risk of ICU admission and length of stay were greater among children with a history of secondhand tobacco smoke exposure (adjusted OR of 4.7 [95% CI: 1.4–18.5] and adjusted incidence rate ratio of 1.7 [95% CI: 1.2–2.3], respectively).[70] A meta-analysis of 60 studies published before November 2010 of infants aged ≤2 years confirmed that smoking by any household member, paternal smoking, maternal prenatal smoking, and maternal postnatal smoking all increased the risk of an infant's lower respiratory tract infection (ORs: 1.54 [95% CI: 1.40–1.69], 1.22 [95% CI: 1.10–1.35], 1.58 [95% CI: 1.45–1.73], and 1.24 [95% CI: 1.11–1.38]).[71]

12. Tobacco smoke exposure increases the risk of middle ear disease.

Quality of evidence: strong

The 2006 Report of the Surgeon General concluded, "The evidence is sufficient to infer a causal

relationship between parental smoking and middle ear disease in children, including acute and recurrent otitis media and chronic middle ear effusion."[25] Using data from the 91 642 interviews completed for the 2007–2008 US National Survey of Children's Health, an association of secondhand smoke exposure with recurrent ear infections for children older than 6 years was demonstrated (adjusted ORs of 1.48 [95% CI: 0.98–2.21] for age 6–11 years and 1.67 [95% CI: 1.02–2.72] for age 12–17 years).[72] A meta-analysis published in 2012 found that maternal postnatal smoking (20 studies) and household smoking (49 studies) increased the risk for otitis media, with ORs of 1.62 (95% CI: 1.33–1.97) and 1.37 (95% CI: 1.25–1.50), respectively.[73]

13. In utero tobacco smoke exposure increases the risk of being overweight in childhood.

Quality of evidence: strong

Both active smoking and secondhand tobacco smoke exposure of the mother during pregnancy increase the child's later risk of being overweight. A prospective follow-up study included 7924 infants of nonsmoking mothers who were born in Hong Kong in April or May 1997, with maternal secondhand tobacco smoke exposure determined at the first postnatal visit.[74] Of those infants, 6790 (86%) had their BMI measured at 7 to 11 years of age. Children of daily paternal smokers had higher mean BMI *z* scores at 7 to 11 years of age, with a mean difference in BMI of 0.10 (95% CI: 0.02–0.19) at 7 years and 0.16 (95% CI: 0.07–0.26) at 11 years. A retrospective cohort study of 1366 fourth grade students in Kumagaya City, Japan, found that those with a history of maternal smoking during pregnancy had a higher mean ± SD BMI (17.2 ± 2.7 vs 16.9 ± 2.5; $P = .016$) when assessed at 9 to 10 years of age.[75] The Millennium Cohort Study prospectively followed up 18 296 healthy term infants in the United Kingdom.[76] Maternal smoking during pregnancy was associated with an increased risk of the child being overweight at 3 years of age (adjusted OR: 1.33 [95% CI: 1.15–1.55]). A meta-analysis of studies published from 1990 to May 2011 identified 7 relevant studies and confirmed the effect of maternal smoking during pregnancy on the risk of the children being overweight (adjusted OR: 1.47 [95% CI: 1.26–1.73]).[77]

14. Tobacco smoke exposure increases the risk of learning and neurobehavioral problems.

Quality of evidence: strong

The 2014 Report of the Surgeon General concluded, "The evidence is sufficient to infer that nicotine exposure during fetal development, a critical window for brain development, has lasting adverse consequences for brain development," and "The evidence is suggestive but not sufficient to infer a causal relationship between maternal prenatal smoking and disruptive behavioral disorders, and attention deficit hyperactivity disorder in particular, among children."[14] Analysis of data from the 2007 US National Survey of Children's Health found that having a history of someone who smokes inside the home increased the child's risk of having attention-deficit/hyperactivity disorder, learning disabilities, and/or conduct disorders reported (adjusted ORs: 1.44 [95% CI: 1.21–1.72], 1.54 [95% CI: 1.27–1.85], and 1.78 [95% CI 1.44–2.21], respectively).[78] A survey of 5494 preschool-aged children in Bavaria, Germany, confirmed that a history of secondhand tobacco smoke exposure was associated with an increase in conduct problems and hyperactivity/inattention that was independent of the effect of maternal smoking before and during pregnancy.[79] The Generation R Study enrolled mothers early in pregnancy and observed them and their children prospectively.[80] Maternal smoking and smoke exposure were assessed during pregnancy, and child behavior problems were assessed at 18 months for 4329 mother–child dyads. Maternal smoking during pregnancy and paternal smoking were both associated with increased behavior problems for the child; however, these findings were not robust to statistical adjustment for psychosocial variables. A study in Finland of administrative data on 175 869 children born 1987 through 1989 found that maternal smoking increased the risk of having a psychiatric diagnosis through 18 years of age in analyses controlling for maternal psychiatric diagnosis and child's gender.[81]

A birth cohort study in Brisbane, Australia, assessed maternal smoking starting at the first prenatal visit.[82] At 14 years of age, the child's academic performance was assessed according to mother's report. Rate of academic performance below average was greater if the mother smoked during pregnancy (adjusted OR: 1.35 [95% CI: 1.07–1.70]), with findings robust to adjustment for multiple potential confounding variables, including maternal age, income, education, alcohol consumption, family communication, and behavior problems. An analysis of computerized population data for children born in Sweden between 1983 and 1987 merged results from birth registries, school and education registries, and census data.[83] The study found that the risk of poor school performance at 15 years of age (mean score below passing) was greater if the mother smoked during pregnancy, with a dose–response effect demonstrated. The OR for poor school performance was 1.58 (95% CI: 1.53–1.62) if the mother smoked 1 to 9 cigarettes per day and 1.89 (95% CI: 1.83–1.96) if the mother smoked ≥10 cigarettes per day during pregnancy. These findings were robust to statistical adjustment for

maternal and birth characteristics. The NHANES III (1988–1994) included both measurement of serum cotinine concentrations and assessments of academic performance for children 6 to 16 years of age in the United States.[84] Children's tobacco exposure, as assessed by using serum cotinine concentrations, was significantly associated with lower scores for reading, math, and visuospatial skills, with even very low cotinine concentrations seeming to have an effect. Findings were robust to statistical adjustment for potentially confounding variables.

15. Tobacco smoke exposure of children leads to findings of preclinical atherosclerosis.

Quality of evidence: strong

A cohort of 545 children in Finland prospectively followed up from infancy through adolescence had serum cotinine concentrations measured annually between 8 and 13 years of age.[85] Carotid intima-media thickness was greater and peak flow–mediated dilation of the brachial artery was lower in children in the highest tertile of tobacco smoke exposure. Similar results were found in a study of 16-year-old male adolescents (N = 610) in Lhasa City, Tibet,[86] and in a case-control study of healthy young adults.[87] Using pooled data from the Cardiovascular Risk in Young Finns study (Finland) and the Childhood Determinants of Adult Health study (Australia), exposure to parental smoking was assessed in 3416 children and carotid intima-media thickness was assessed in adulthood, 21 to 28 years later. If both parents smoked at baseline, the child's carotid intima-media thickness in adulthood was greater (mean: 0.652 vs 0.637 mm; P = .003 in fully adjusted analyses).[88] This study did not find that smoking by 1 parent had an effect; however, the study did not differentiate maternal from paternal smoking. This omission may be important because maternal smoking generally has a greater effect on a child's level of tobacco smoke exposure.[13]

Soluble intercellular adhesion molecule 1 (s-ICAM1) is a measure of endothelial stress, and hair cotinine is a biomarker of tobacco smoke exposure. In a sample of children aged 9 to 18 years in Columbus, Ohio, hair cotinine concentrations were positively correlated with s-ICAM1 levels.[89] A substantial amount of the variance in s-ICAM1 was accounted for by hair cotinine level of the child (partial R^2 = 0.26, P = .0001 for the association of log hair cotinine with s-ICAM1 level in multivariate models adjusting for BMI, age, mean blood pressure, and very low-density lipoprotein level).

16. Tobacco smoke exposure increases the risk of childhood cancers.

Quality of evidence: good

The 2006 Report of the Surgeon General concluded, "The evidence is suggestive but not sufficient to infer a causal relationship between prenatal and postnatal exposure to secondhand smoke and childhood cancer."[25] Additional evidence of an association between childhood cancers and tobacco smoke exposure has accumulated since this 2006 report. Tobacco-specific carcinogens have been detected in the blood of children who have a tobacco smoker in the home.[90] A case-control study of children with acute lymphoblastic leukemia (ALL) in Australia found that a history of paternal smoking of ≥15 cigarettes per day during the pregnancy year was associated with an increased risk of childhood ALL, with an OR of 1.46 (95% CI: 1.05–2.01).[91] The authors then pooled their results with 9 other relevant studies and documented a modest increased risk of paternal prenatal smoking on childhood ALL, with an OR of 1.15 (95% CI: 1.06–1.24). A case-control study of childhood (<14 years) cancers in Shiraz, Iran, found that paternal smoking before and during pregnancy and maternal secondhand smoke exposure during pregnancy were associated with an increased cancer risk in children, with ORs of 1.8 (95% CI: 1.4–6.0), 3.0 (95% CI: 1.4–5.0), and 3.6 (95% CI: 1.3–5.0), respectively.[92] The Australian Study of Childhood Brain Tumors, a national population-based case-control study conducted between 2005 and 2010, found that maternal smoking before and during pregnancy was associated with increased risk of brain tumors diagnosed before 2 years of age, with ORs of 5.06 (95% CI: 1.35–19.00) and 4.61 (95% CI: 1.08–19.63).[93]

17. Smoke-free homes may reduce children's tobacco smoke exposure.

Quality of evidence: good

Smoke-free homes and cars may reduce children's tobacco smoke exposure but are unlikely to completely protect a child as long as household members are smokers. A randomized controlled trial of an intensive intervention to implement smoke-free homes in Ankara, Turkey, found substantial reductions in urine cotinine levels over 12 months of follow-up in the intervention group but not in the control group.[94] A randomized controlled study among Latino families in Houston, Texas, in which an adult was a smoker compared provision of 2 culturally appropriate fotonovelas (illustrated storybooks) and 1 comic book, which were designed to promote a tobacco-free indoor environment, versus use of a standard smoking cessation guide published by the American Cancer Society. At the 12-month follow-up, there were more reported bans on in-home smoking for the intervention (fotonovela) condition (73% vs 56%). Although the results did not differ according to intervention group, those homes with an in-home smoking ban had reduced nicotine concentrations on the home

surfaces sampled (0.04 ± 0.04 $\mu g/m^3$ vs 0.47 ± 0.66 $\mu g/m^3$; $P < .01$).[95] A study in Columbus, Ohio, of children younger than 3 years found that when the mother was a smoker, hair cotinine concentrations were not significantly different if the mother reported smoking inside or outside.[96]

18. Tobacco dependence almost always develops before reaching the age of majority.

Quality of evidence: strong

Tobacco is a substance of abuse. The 2012 Report of the Surgeon General concluded, "Given their developmental stage, adolescents and young adults are uniquely susceptible to social and environmental influences to use tobacco," and "Among adults who become daily smokers, nearly all first use of cigarettes occurs by 18 years of age (88%), with 99% of first use by 26 years of age."[4]

Nicotine dependence develops early and drives the progression from intermittent to daily smoking. A study of 1246 English-speaking students from central Massachusetts enrolled students in sixth grade and monitored them prospectively for 4 years.[97,98] Of the 370 subjects who had inhaled from a cigarette, the median age at first cigarette use was 12 years. At least 1 symptom of early nicotine dependence was reported by 33% of participants who had ever puffed on a cigarette. Experiencing any symptom of nicotine dependence increased the risk of progressing to monthly smoking (adjusted hazard ratio: 3.7 [95% CI: 2.4–5.5]) or daily smoking (adjusted hazard ratio: 6.8 [95% CI: 4.4–10.5]). Analyses of data from the 2004 NYTS found that among the 2580 adolescent smokers aged 12 to 18 years who participated in the survey, there was a strong correlation between nicotine withdrawal symptoms and both the amount and frequency of smoking.[99]

19. Tobacco dependence is a treatable chronic illness.

Quality of evidence: strong

The 2008 US Public Health Service–sponsored clinical practice guideline advised that "Clinicians strongly recommend the use of effective tobacco dependence counseling and medication treatments to their patients who use tobacco, and that health systems, insurers, and purchasers assist clinicians in making such effective treatments available."[100] Even brief advice can increase quit rates.[101]

A 2013 Cochrane review concluded that nicotine replacement therapy, bupropion, varenicline, and cytisine (a nicotine receptor partial agonist, not currently available in the United States) improved the chances of stopping smoking.[102] Combination nicotine replacement therapy outperformed single formulations. Forms of nicotine replacement therapy that are approved by the FDA for tobacco dependence treatment are nicotine patches, nicotine gum, and nicotine lozenges (available over the counter in the United States) as well as nicotine nasal spray and nicotine inhalers (available only by prescription in the United States).

The 2009 American College of Chest Physicians' Tobacco Dependence Treatment ToolKit advises, "Approaching tobacco dependence as a chronic disease acknowledges the altered central nervous system (CNS) neurobiology in tobacco-dependent patients. The goal of therapy in tobacco dependence is to normalize brain function—so that the patient has minimal to no symptoms of nicotine withdrawal, thus allowing the patient to feel (near) normal while not using tobacco. The intensity of treatment should be based on the severity level of nicotine dependence. For highly nicotine-dependent patients, combination therapy is often needed."[103] Adhering to the model of asthma and other chronic diseases regarding exacerbations and remissions, the longer acting medications can be thought of as "controllers," with the faster acting medications used as "relievers."

In studies of tobacco-dependent adults, initiation of nicotine replacement therapy before stopping smoking improves the effectiveness of treatment. A multisite, randomized clinical trial with parallel groups (placebo and active treatment–controlled) included 400 tobacco-dependent adult subjects in North Carolina.[104] It provided an intervention of a 21-mg nicotine patch versus placebo daily for 2 weeks before cessation, with active nicotine patch (no placebos) provided for all subjects after the stop smoking date. Precessation treatment with the nicotine patch substantially improved quit rates, with the greatest benefit for those with lower levels of nicotine dependence (Fagerström Test for Nicotine Dependence [FTND] score <6). For smokers with lower FTND scores, 10-week continuous abstinence rates were 33.8% in the precessation nicotine patch condition versus 9.3% in the placebo patch condition. In contrast, for smokers with higher FTND scores, abstinence rates did not differ significantly between patch conditions (14.0% in the precessation nicotine patch condition vs 10.8% in the placebo patch condition). A meta-analysis identified 4 relevant studies completed before February 2007 and found that precessation therapy with a nicotine patch doubled abstinence rates at 6 weeks and 6 months (ORs: 1.96 [95% CI: 1.31–2.93] and 2.20 [95% CI: 1.39–3.48], respectively).[105]

For further details on practical, evidence-based, expert consensus recommendations for tobacco dependence treatment, the reader is referred to the American College of Chest Physicians' Tobacco Dependence Treatment ToolKit (http://tobaccodependence.chestnet.org).

RECOMMENDED ACTIONS FOR PEDIATRICIANS

1. Inquire about tobacco use and tobacco smoke exposure as part of health supervision visits and visits for diseases that may be caused or exacerbated by tobacco smoke exposure.

Evidence quality: B

Recommendation strength: strong recommendation

It is important to identify tobacco use so that appropriate interventions can be offered to prevent tobacco use initiation, recommend stopping smoking, and/or recommend treatment of tobacco dependence. It is important that tobacco smoke exposure be identified so that interventions can be offered to reduce this exposure. The Memphis Health Project, a longitudinal study of smoking in 5154 adolescents, found that participants who were both screened and advised had more knowledge about the health risks of smoking and more negative perceptions of the social value of smoking than participants with no intervention or screening.[106] Recall of physician communication was associated by teenagers with improved perceptions of the dangers of smoking. The adolescents who were smokers reported more quit attempts and fewer intentions to continue to smoke when they reported recall of physician advice. Analyses of data from the 18 866 respondents of the 2011 NYTS found low rates of recalled health care provider screening for tobacco use (32.2% [95% CI: 30.2–34.1]).[107] Among current youth smokers, receipt of health professional counseling was associated with having made an attempt to stop smoking (OR: 1.39 [95% CI: 1.15–1.68]). Similar results were found on analyses of data from the 24 573 participants in the 2000 NYTS.[108]

2. Include tobacco use prevention as part of anticipatory guidance.

Evidence quality: B

Recommendation strength: strong recommendation

The US Preventive Services Task Force (USPSTF) recommends that primary care clinicians provide interventions, including education or brief counseling, to prevent initiation of tobacco use in school-aged children and adolescents.[109] The USPSTF report concluded, "The USPSTF found adequate evidence that behavioral counseling interventions, such as face-to-face or phone interaction with a health care provider, print materials, and computer applications, can reduce the risk for smoking initiation in school-aged children and adolescents." A meta-analysis of behaviorally based interventions to prevent tobacco use initiation found 10 relevant trials with a pooled risk ratio of 0.81 (95% CI: 0.70–0.93).[110]

3. Address parent/caregiver tobacco dependence as part of pediatric health care.

Evidence quality: B

Recommendation strength: strong recommendation

Because tobacco smoke exposure is harmful to the child, and parental tobacco smoking is an important source of a child's tobacco smoke exposure, addressing parental and caregiver tobacco dependence is important in protecting the health of the child. According to the US Public Health Service–sponsored evidence-based guideline *Treating Tobacco Use and Dependence: 2008 Update*, "It is essential that clinicians and health care delivery systems consistently identify and document tobacco use status and treat every tobacco user seen in a health care setting."[100]

An assessment of parents of tobacco smoke–exposed children with asthma who enrolled in a clinical trial found that most of the primary caregivers who were tobacco smokers were interested in stopping smoking; 56.5% were at the contemplation or better stage of change.[13]

Tobacco dependence treatment or recommendation for treatment by pediatricians is acceptable to most parents. A nationally representative (US) telephonic survey included 730 parents who had accompanied a child to a health care visit in the past year, of whom 21% were tobacco smokers.[111] The survey found that most (59.7%) of the smokers thought it would be acceptable to have the child's physicians prescribe or recommend a tobacco dependence treatment medication for them.

3a. Recommend tobacco dependence treatment of tobacco-dependent parents and caregivers.

Evidence quality: B

Recommendation strength: strong recommendation

According to the US Public Health Service–sponsored evidence-based guideline *Treating Tobacco Use and Dependence: 2008 Update*, "Counseling and medication are effective when used by themselves for treating tobacco dependence. The combination of counseling and medication, however, is more effective than either alone. Thus, clinicians should encourage all adults making an attempt to stop tobacco to use both counseling and medication."[100]

Behaviorally based interventions for parental tobacco dependence have limited benefit; interventions that include use of medications show greater efficacy. A clinical trial of cotinine feedback and behavioral counseling for parents of tobacco smoke–exposed children with asthma found no significant intervention effect; however, on subgroup analyses, children with high-risk asthma who received the intervention had a greater reduction in the ratio of urine cotinine to creatinine than did

the control group.[112] A meta-analysis of studies designed to protect children from tobacco smoke exposure through parental cessation or modification of parental smoking identified 18 relevant studies published through March 2011.[113] Studies had substantial variation in the methods and interventions tested. The relative risk of parental smoking cessation from the pooled study results was 1.34 (95% CI: 1.05–1.71). The impact was greatest in the subgroup of 2 studies that included the use of nicotine replacement therapy in the intervention (risk ratio: 3.13 [95% CI: 1.19–8.21]).

3b. Implement systems to identify and offer counseling, treatment, treatment recommendations, and/or referral for tobacco-dependent parents.

Evidence quality: C

Recommendation strength: recommendation

Practical systems have been developed and validated to address parental tobacco dependence as part of the child's health care. A summary of counseling approaches is described in Table 3. A randomized controlled clinical trial involving 22 practices in the Pediatric Research in Office Settings network tested the use of the Clinical Effort Against Secondhand Smoke Exposure (CEASE) program.[114] The intervention included: (1) routine screening for parental tobacco use; (2) motivational messaging based on the parents' own concerns; and (3) recommendation and possible provision of nicotine patch and gum by the clinician and enrollment in the free state (telephone) quitline. On exit interview, parental smokers in the intervention practices reported a higher rate of discussing methods to stop smoking (24% vs 2%; $P < .001$), prescription of nicotine replacement medication (12% vs 0%; $P < .001$), and enrollment in the state (telephonic) quitline (10% vs 0%; $P < .001$).

TABLE 3 Counseling Approaches

CEASE program: Ask, Assist, Refer[114,188]
Ask. Does your child live with anyone who uses tobacco?
Assist. Assist families to stop using tobacco and eliminating tobacco smoke exposure. This assistance includes both counseling and recommendations or prescriptions for medication
Refer. Refer families who use tobacco for outside help, such as the state or national telephonic quitline (1-800-QUIT-NOW in the United States)
American College of Chest Physicians Tobacco Dependence Treatment ToolKit: Assess, Recommend, Monitor, Revise[103]
Assess and diagnose
Recommend a treatment plan. The treatment plan should be based on the level of nicotine dependence, with more dependent patients needing more aggressive therapy
Monitor the treatment plan's outcome
Revise the treatment plan to improve effectiveness and minimize adverse effects. Base effectiveness on achieving control of nicotine withdrawal
ASKNOW: A Stage of Change theory–based counseling strategy[189]
Assess the health behavior
Determine the stage of change
Keep in mind key facts
Jointly negotiate an action plan
Observe outcome in follow-up
Work toward the next stage
Stage of Change theory of health behavior change[103,190]
Precontemplation—Patient has no intention of changing behavior
Stage-matched interventions include:
1. Assess roadblocks to the proposed change
2. Discuss the relevance, risks, and rewards of the proposed change
3. Determine what action the patient and/or family is willing to take
Contemplation—Patient intends to make the behavior change within the next 6 mo but makes no commitment to action
Stage-matched interventions include:
1. Assess roadblocks, including level of nicotine dependence
2. Assess opportunities to overcome roadblocks
3. Recommend appropriate pharmacotherapy
4. Build confidence that the patient can make a change that has beneficial results
Preparation—The intention is to implement the behavior change soon, within 1 month
Stage-matched interventions include:
1. Assess the specific changes needed
2. Recommend and/or prescribe appropriate pharmacotherapy
3. Facilitate the development of specific plans for smoking cessation
Action—Patient has made the behavior change recently (within the past 6 mo); relapse risk is at its highest
Stage-matched interventions:
1. Monitor for difficulties and lapses
2. Discuss strategies to recover from them
a. Consider if treatment plan needs modification
3. Discuss how to handle difficult situation
4. Provide positive reinforcement
Maintenance—Six months to life postchange; the risk of relapse is still present, although not as high
Stage-matched interventions:
1. Ask about lapses and temptations to lapse
2. If nicotine withdrawal symptoms are in good control, consider if pharmacotherapy can be stepped down

CEASE, Clinical Effort Against Secondhand Smoke Exposure.

Before prescribing tobacco dependence treatment for parents, pediatricians should verify that their medical liability insurance provides coverage for care offered to adults. If the pediatrician elects to prescribe for parents, he or she should conduct an appropriate assessment of disease (tobacco dependence), consider possible contraindications to the medications, counsel about risks and benefits, offer recommendations for follow-up, and provide appropriate treatment. Follow-up is important to

monitor for adherence to treatment recommendations, adverse effects of medications prescribed or used, correct technique for use of the recommended treatments, adequacy of treatment in controlling nicotine withdrawal symptoms, and stage of change in relation to stopping tobacco use and in relation to accepting tobacco dependence treatment. Pediatricians should follow state regulations and institutional policies for charting on care provided for parents and caregivers to benefit the health of the child. Electronic health record systems should facilitate adherence to documentation requirements without placing excessive burdens on the parent or pediatrician.

4. Offer tobacco dependence treatment and/or referral to adolescents who want to stop smoking.

Evidence quality: B

Recommendation strength: strong recommendation

4a. Tobacco dependence pharmacotherapy can be considered for moderate to severely tobacco-dependent adolescents who want to stop smoking.

Evidence quality: D

Recommendation strength: option

Tobacco dependence treatment of adolescents has varying degrees of success in stopping smoking, with results contingent on the severity of the dependence. Behaviorally based programs for tobacco-dependent adolescents are effective and are most beneficial for those with minimal to mild degrees of dependence. The most effective of the behaviorally based programs are developmentally relevant and focus on contingency management skills, stage of change-based motivational interviewing, social support, or a combination of these methods.[115] Although more benefit is observed with more intensive interventions, even brief counseling by physicians can be of assistance, with effects enhanced by repeated advice.[101]

Although still beneficial compared with nonintervention, behaviorally based programs have much lower rates of smoking cessation among teenagers who are severely tobacco dependent. For example, Project EX (an 8-session, school-based clinic tobacco use cessation program for adolescents that includes enjoyable, motivating activities) found that 30-day abstinence from smoking on completion of the program was 42% for those with minimal to mild tobacco dependence but only 7% for those with severe tobacco dependence.[116] Similar results were found in evaluation of the Not On Tobacco program; at 3 months' follow-up, 24% of those with minimal to mild nicotine dependence reported not smoking, but only 9.4% of those with severe nicotine dependence reported not smoking.[117] Clinical trials of motivational interviewing versus brief advice (without medication use) for tobacco-dependent adolescents yielded very low stop-smoking rates that did not differ between treatment groups.[118,119]

There is emerging evidence documenting a benefit of pharmacotherapy for tobacco-dependent adolescents; adherence is challenging, however, and relapse after brief courses of treatment is common. Investigators compared the use of a nicotine patch versus nicotine gum versus placebo in a randomized, double-blind, placebo-controlled clinical trial with 120 adolescents who wanted to stop smoking and had moderate or greater tobacco dependence.[120] Medication was initiated on the planned stop-smoking day and continued for 12 weeks. Group cognitive behavioral therapy was provided to all participants. At 1 week after the stop-smoking date, 26.5% of those receiving the nicotine patch, 17.4% of those receiving the nicotine gum, and 5.0% of the placebo group were not smoking (P = .02 for patch versus placebo). By 3 months after pharmacotherapy was discontinued, nonsmoking rates were 20.6% for the patch, 8.7% for the gum, and 5% for placebo (P = .06 for patch versus placebo). Adherence to daily use of the patch was acceptable at 78.4%; adherence to use of the nicotine gum was poor at 38.5%. Analyses of trial participants who had stopped smoking and then restarted found that those who restarted smoking after a period of abstinence had greater craving scores, suggesting that inadequately controlled withdrawal contributed to the lapse.[121] A randomized, double-blind, placebo-controlled, parallel-group clinical trial included 6 weeks of bupropion plus counseling for tobacco-dependent adolescents.[122] The authors found improved rates of smoking cessation with 150 mg of bupropion twice daily when the medication was being taken (29% abstinent at 6 weeks with bupropion vs 16% with placebo [P = .02]); the benefit was quickly lost after the medication was stopped, however.

Because there has been limited research on tobacco dependence pharmacotherapy in adolescents, the FDA-approved labeling for these medications states, "Safety and effectiveness in the pediatric population have not been established." Because tobacco dependence is a severe chronic illness that debilitates, harms offspring, and shortens life, it is reasonable to consider that pharmacotherapy documented as effective in adults is an option for the treatment of adolescents with moderate to severe tobacco dependence. Given the high rates of nonadherence during therapy and relapse after discontinuation of therapy among adolescents in the trials of these medications, close follow-up is recommended.

5. Offer tobacco-dependent individuals quitline referral.

Evidence quality: A

Recommendation strength: strong recommendation

Studies among adults found that free (to the user) telephonic tobacco dependence treatment is beneficial; however, research among teenagers is not yet available, and the services provided vary substantially. Callers to the California Smokers' Helpline during periods of high call volume who were ready to stop smoking were randomized to be immediately assigned to a counselor (treatment) or asked to call back (control).[123] All callers were sent written self-help materials. Twelve-month abstinence rates were 9.1% in the treatment group versus 6.9% in the control group ($P < .001$), with the entire difference in the control group attributable to those members who did not call back to receive assistance. A recent Cochrane review of telephonic counseling for smoking cessation found 77 trials that met inclusion criteria.[124] Among smokers who contacted helplines, quit rates were higher for groups randomized to receive multiple sessions of proactive counseling (9 studies, >24 000 participants; relative risk for cessation at longest follow-up: 1.37 [95% CI: 1.26–1.50]).

6. Consider potential for neuropsychiatric symptoms with tobacco dependence treatment.

Evidence quality: C

Recommendation strength: recommendation

Pediatricians should be aware of the increased risk of suicidal ideation and suicide, both among continuing smokers and among those being treated for tobacco dependence. In studies among adults, suicide is associated with cigarette use in a dose-dependent manner.[125–127] Studies of adolescent population samples and youth with bipolar disorder demonstrate an association between tobacco use and suicide risk.[128,129] In postmarketing surveillance, suicidal ideation and suicide have been reported among patients taking varenicline and bupropion, with a black box warning issued by the FDA for both medications.[130] A study of 119 546 adults in England who used a smoking cessation product found no differences in rates of treated depression, nonfatal self-harm, and fatal self-harm within 3 months of the first smoking cessation prescription; the study compared those who received varenicline or bupropion with those who received nicotine replacement.[131] Neuropsychiatric symptoms associated with tobacco dependence treatment may reflect inadequate control of nicotine withdrawal.[103]

Comorbidities of substance abuse and psychiatric disorders may accompany tobacco dependence[14] and can make tobacco dependence more difficult to treat. These comorbidities, when identified, should be addressed through appropriate referral.

The risk of treatment-emergent neuropsychiatric symptoms should be balanced against the substantial harms of continued tobacco use. As with any other prescribing, the discussion of risks versus benefits should be documented in the health record.

7. Do not recommend electronic nicotine delivery systems for tobacco dependence treatment.

Evidence quality: B

Recommendation strength: strong recommendation

Electronic nicotine delivery systems have not been shown to be effective for smoking cessation.[132] There is currently no regulation on content or manufacturing standards for electronic nicotine delivery systems. In addition to nicotine, carcinogens, toxins, metals, and silicates have been found in the emissions from these devices.[133–135] The adverse effects of long-term inhalation of the flavoring agents used is not known, and some commonly used agents are known respiratory irritants.[136]

Pediatricians should direct patients who want pharmacotherapy for tobacco dependence to therapies that have been documented to be effective and are approved as such by the FDA. In New Zealand, a clinical trial of e-cigarettes for smoking cessation among moderately to severely tobacco-dependent adults found low cessation rates and no statistically significant difference between the use of nicotine-containing e-cigarettes and placebo.[137]

Among adolescents, the use of e-cigarettes is associated with decreased rates of stopping smoking. A nationally representative survey of middle and high school students in Korea found that among current adolescent smokers, although there were more attempts to stop smoking among e-cigarette users (OR: 1.67 [95% CI: 1.48–1.90]), current e-cigarette users were much less likely to have stopped using cigarettes (OR: 0.10 [95% CI: 0.09–0.12]) compared with smokers who never used e-cigarettes.[138] An analysis of 2011 and 2012 NYTS data found that among smokers (having smoked at least 100 cigarettes in their lifetime) who had ever used e-cigarettes, both ever having used e-cigarettes and current e-cigarette use were associated with lower rates of abstinence from cigarette smoking (ORs of 0.32 [95% CI: 0.18–0.56] and 0.34 [95% CI: 0.13–0.87], respectively, for 1 year or greater abstinence; ORs of 0.61 [95% CI: 0.42–0.89] and 0.35 [95% CI: 0.18–0.69] for more than 30 days but less than 6 months' abstinence from cigarettes).[139]

8. If the sources of a child's tobacco smoke exposure cannot be eliminated, provide counseling about strategies to reduce the child's tobacco smoke exposure.

Evidence quality: C

Recommendation strength: recommendation

A randomized, single-blind study of 352 children aged 8 to 16 years in Ankara, Turkey, tested a smoke-free home intervention aimed at increasing household smoking bans and reducing secondhand smoke exposure. Those randomized to the smoke-free home intervention had greater rates of in-home smoking restrictions and substantially lower urine cotinine levels at 2, 6, and 12 months of follow-up.[94] A randomized, single-blind study in 91 Mexican-American households used low literacy fotonovelas and a comic book to promote a tobacco-free indoor air environment.[95] The study found that a greater proportion of households in the intervention group implemented bans on smoking inside of the home. Although the study found no differences in ambient nicotine level according to intervention group, those households that implemented a ban on smoking indoors had lower ambient nicotine levels than households that did not implement such a ban.

A randomized single-blind study compared an in-home motivational interviewing intervention versus provision of written information by mail in households with children aged <3 years and a parent/caregiver who is a smoker.[140] Ambient nicotine levels measured in the kitchen and the room with a television were lower in the motivational interviewing intervention group than in the written information control group.

A convenience sample of 291 children ages 2 weeks to 3 years was recruited from a clinic that serves predominantly low-income families in Columbus, Ohio.[96] Maternal smoking was reported in 41% of the sample. The report of an in-home smoking ban was associated with decreased hair cotinine levels, although the child's hair nicotine level did not differ regardless of whether the mother reported smoking outside only.

A single-blind, randomized controlled clinical trial of cotinine feedback plus behavioral counseling to reduce tobacco smoke exposure among tobacco smoke–exposed children with asthma in Northern California found no overall intervention effect; however, the subgroup of children with high-risk asthma had lower urine cotinine levels on follow-up.[112]

PUBLIC POLICY RECOMMENDATIONS

1. The FDA should regulate all tobacco products to protect the public health.

Evidence quality: X

Recommendation strength: strong recommendation

The FDA is charged with the mission of protecting consumers and enhancing public health by maximizing compliance of FDA-regulated products and minimizing risks associated with those products. The FDA Center for Tobacco Products is responsible for carrying out the Family Smoking Prevention and Tobacco Control Act, passed in 2009 in an effort to protect the public and create a healthier future for all Americans.[141] This act puts in place restrictions on marketing tobacco products to children and gives the FDA the authority to take action in the future to protect public health. Some of the agency's responsibilities under the law include setting performance standards, reviewing premarketing applications for new and modified-risk tobacco products, and requiring new warning labels for tobacco products.[142]

2. Tobacco control should be adequately funded.

Evidence quality: A

Recommendation strength: strong recommendation

Tobacco dependence treatment should be available to tobacco-dependent individuals of all ages. Given the important benefits to society of reducing tobacco dependence, cost should not be a barrier to program participation and access to tobacco dependence treatment medications. The *Best Practices for Comprehensive Tobacco Control Programs—2014* guidelines from the Centers for Disease Control and Prevention (CDC) should be implemented with funding at or near recommended levels.[143] This funding will ensure that tobacco control programs are available to those who need them.

The CDC's Community Preventive Services Task Force evidence review found strong support for the effectiveness of comprehensive tobacco control programs in reducing tobacco use and secondhand smoke exposure, independent of increases in tobacco product prices or adoption of smoke-free policies.[144] These programs reduce the prevalence of tobacco use among adults and young people, reduce tobacco product consumption, increase quitting, and contribute to reductions in tobacco-related diseases and deaths. Increases in program funding are associated with increases in program effectiveness, with the greatest impact seen if programs are funded at CDC-recommended levels.

Tobacco control research should be considered a high priority and funded accordingly from both government and private sources. Tobacco industry funding should not be used for this purpose. The tobacco industry has a long history of using industry-funded programs to divert attention away from

effective tobacco control programs and research, as well as misusing health care providers and academia to thwart attempts at tobacco control.[14]

Recommendations for Public Policy to Protect Children From Tobacco Use Initiation

3. Tobacco product advertising and promotion in forms that are accessible to children and youth should be prohibited.

Evidence quality: B

Recommendation strength: strong recommendation

Tobacco promotion is an important cause of initiation of tobacco use among youth. Major conclusions of the 2012 Report of the Surgeon General included, "Advertising and promotional activities by tobacco companies have been shown to cause the onset and continuation of smoking among adolescents and young adults." The report also concluded, "In 2008, tobacco companies spent $9.94 billion on the marketing of cigarettes and $547 million on the marketing of smokeless tobacco. Spending on cigarette marketing is 48% higher than in 1998," and "The evidence is suggestive but not sufficient to conclude that tobacco companies have changed the packaging and design of their products in ways that have increased these products' appeal to adolescents and young adults."[4]

4. Point-of-sale tobacco product advertising and product placement that can be viewed by children should be prohibited.

Evidence quality: B

Recommendation strength: strong recommendation

Point-of-sale advertising increases tobacco initiation and tobacco product use among youth. Analysis of data from the 2011 NYTS found that youth who reported higher levels of exposure to advertisements in retail establishments had higher rates of trying snus and e-cigarettes (adjusted ORs: 3.33 [95% CI: 2.66–4.18] and 1.71 [95% CI: 1.21–2.41], respectively) comparing most of the time or always viewing retail tobacco advertisements versus never or rarely.[145] Students in Tracy, California, were surveyed in grades 6 through 8 with follow-up surveys at approximately 12 months and 30 months later. Convenience stores, small markets, and liquor stores typically contain the most cigarette advertising. These cues were noticeable to students who had never smoked, with 82.1% of the sample reporting seeing cigarette advertisements in stores. The study found that a moderate (0.5–1.9 per week) and high (2.0–18 per week) number of visits to these stores were associated with increased rates of smoking initiation at 12 months (ORs: 1.64 [95% CI: 1.06–2.55] and 2.58 [95% CI: 1.68–3.97]) and at 30 months' follow-up (ORs: 1.19 [95% CI: 1.00–1.41]) and 1.42 [95% CI: 1.19–1.69]).[146] The results from the 2005–2006 California Student Tobacco Survey were matched to retailer licensing data about the location of tobacco outlets and with observations regarding the quantity of cigarette advertising in a random sample of those stores. The study found that the prevalence of current smoking was 3.2 percentage points higher at schools in neighborhoods with the highest tobacco outlet density (>5 outlets) than in neighborhoods with no tobacco outlets.[147] Analyses of data from the 1999–2003 Monitoring the Future surveys matched to data on retail cigarette marketing found that higher levels of advertising, lower cigarette prices, and greater availability of cigarette promotions were associated with smoking uptake.[148] A virtual store experiment found that youth aged 13 to 17 years were substantially less likely to try purchasing tobacco products when tobacco products were not displayed (OR: 0.30 [95% CI: 0.13−0.67]).[149]

5. Depictions of tobacco products in movies and other media that can be viewed by youth should be restricted.

Evidence quality: B

Recommendation strength: strong recommendation

Depictions of smoking in the movies have been repeatedly shown to increase rates of smoking initiation among adolescents both in the United States and globally. The 2012 Report of the Surgeon General concluded, "The evidence is sufficient to conclude that there is a causal relationship between depictions of smoking in the movies and the initiation of smoking among young people."[4] In a prospective study of a nationally representative sample of US adolescents aged 10 to 14 years recruited in 2003 and followed up for 24 months, the adjusted hazard ratios for smoking initiation were 1.90 (95% CI: 1.47–2.45), 1.91 (95% CI: 1.49–2.44), and 2.02 (95% CI: 1.52–2.67) for views of tobacco use by negative, mixed, and positive movie characters, respectively.[150] A school-based prospective follow-up study of 9987 children (mean ± SD age: 13.15 ± 1.10 years) in 6 European countries documented an adjusted incidence rate ratio for smoking initiation of 1.13 (95% CI: 1.08–1.17) for each additional 1000 occurrences of movie smoking exposure.[151] A school-based cross-sectional survey of 4943 adolescents 12 to 16 years of age in New Delhi, India, found that the adjusted odds of ever having used tobacco among adolescents with high exposure to smoking in movies was 2.3 (95% CI: 1.3–3.9) compared with those with low exposure.[152]

6. The promotion and sale of electronic nicotine delivery systems to youth should be prohibited.

Evidence quality: B

Recommendation strength: strong recommendation

Nicotine is a highly addictive substance. The 2010 Report of the Surgeon General produced a major conclusion: "Nicotine is the key chemical compound that causes and sustains the powerful addicting effects of commercial tobacco products."[20] Electronic nicotine delivery systems have the potential to serve as introductory products and to escalate levels of nicotine dependence among youth. An analysis of 2011 and 2012 NYTS data found that among cigarette experimenters (ever smoked a puff), a history of both ever and current e-cigarette use was associated with being a current cigarette smoker (ORs: 5.96 [95% CI: 5.67–6.27] and 7.88 [95% CI: 6.01–10.32], respectively).[139]

7. Tobacco control programs should change the image of tobacco by telling the truth about tobacco.

Evidence quality: B

Recommendation strength: strong recommendation

Tobacco control programs that denormalize tobacco use by changing the image that youth have about tobacco and nicotine products can be effective. Tobacco industry–sponsored programs have been ineffective. The 2012 Report of the Surgeon General concluded, "The evidence is sufficient to conclude that school-based programs with evidence of effectiveness, containing specific components, can produce at least short-term effects and reduce the prevalence of tobacco use among school-aged youth," and "The tobacco companies' activities and programs for the prevention of youth smoking have not demonstrated an impact on the initiation or prevalence of smoking among young people."[4]

The *Best Practices for Comprehensive Tobacco Control Programs—2014* of the CDC concluded the following: "Mass-reach health communication interventions can be powerful tools for preventing the initiation of tobacco use, promoting and facilitating cessation, and shaping social norms related to tobacco use."[143] The Community Preventive Services Task Force (2013) recommended mass-reach health communication interventions based on strong evidence of effectiveness in decreasing the prevalence of tobacco use, increasing cessation and use of available services such as quitlines, and decreasing the initiation of tobacco use among young people.[153]

Adolescents and young adults are very sensitive to perceived social norms and media presentations of smoking behavior. Florida appropriated $23 million in fiscal year 1997 and $70 million in fiscal year 1998 to fund the Florida Tobacco Pilot Program to prevent and reduce tobacco use among Florida's youth.[154] The program's major component was a youth-oriented, countermarketing media campaign developed to reduce the allure of smoking; the other program components comprise community partnerships in all 67 Florida counties, an education and training initiative, and enhanced enforcement of youth tobacco access laws. From 1998 to 1999, the prevalence of current cigarette use declined from 18.5% to 15.0% ($P < .01$) among middle school students and from 27.4% to 25.2% ($P = .02$) among high school students. Current cigar use declined among middle school students from 14.1% in 1998 to 11.9% in 1999 ($P < .01$). Smokeless tobacco use declined among middle school students from 6.9% in 1998 to 4.9% in 1999. This decline has been larger than any annual decline observed nationally among youth since 1980. In January 2008, Panama adopted Law No. 13, which intensified tobacco control measures by prohibiting pro-tobacco statements on cigarette packages; requiring complete prohibition of any form of pro-tobacco advertising, promotion, or sponsorship in all venues, including sports venues; prohibiting tobacco consumption in all enclosed work environments; and requiring the integration of content on the health consequences of tobacco consumption into the curricula of general education and basic secondary education.[155] From 2002 to 2008, the prevalence of current cigarette smoking among students 13 to 15 years of age in Panama decreased from 13.2% to 4.3%.

Pictorial health warnings improve adolescents' awareness of the harms of smoking and decrease their perceptions of the social appeal of smoking. A survey of 4482 adolescents in Melbourne, Australia, found that adolescents had more accurate perceptions of the health risks of smoking if they had seen the graphic warnings.[156] Focus groups of adolescents in Auckland, New Zealand, found that graphic warning labels clearly prompted a more severe judgement of smokers' social appeal.[157]

8. Tobacco product prices should be increased to reduce youth tobacco use initiation.

Evidence quality: B

Recommendation strength: strong recommendation

The US Task Force on Community Preventive Services (2001) strongly recommended increasing the unit price for tobacco products to reduce smoking initiation and reduce consumption of tobacco products.[158] Data from the Global Youth Tobacco Survey were matched to data on cigarette prices and estimated overall price elasticity (the relationship between demand for a product and its price) at –1.5; for low- and middle-income countries, however, price

elasticity was greater at −2.2, suggesting that a 10% price increase would decrease youth smoking by 22%.[159] Increasing the tobacco tax has the benefit of both raising the price and providing a source of funds that can be used for tobacco control programs.

9. The minimum age to purchase tobacco should be increased to 21 years.

Evidence quality: B

Recommendation strength: strong recommendation

In 2005, Needham, Massachusetts, raised the minimum age for the purchase of tobacco to 21 years; by 2010, the youth smoking rate had dropped by nearly one-half (12.9% to 6.7%), a change not observed in surrounding communities.[160] The minimum age for the legal purchase of tobacco increased from 16 to 18 years in England, Scotland, and Wales on October 1, 2007. Data from the 2003–2008 Smoking, Drinking and Drug Use Among Young People in England, an annual survey of youths aged 11 to 15 years, reported a substantial reduction in regular smoking among 11- to 15-year-olds after the minimum age was increased (adjusted OR: 0.67 [95% CI: 0.55–0.81]).[161] In Massachusetts cities in which compliance with underage purchase was enforced and verified, focus groups of adolescent smokers found that for high school–aged smokers, teenage store clerks and friends who are aged ≥18 years are major sources of attaining tobacco products.[162] An analysis of Canada's 1994–1995 National Population Health Survey found that most smokers began daily smoking in their teenage years, with 16% of 21- to 39-year-olds who had ever smoked daily reporting that they had started to do so at ≤13 years of age; 55% reported starting smoking at 14 to 17 years of age; and 15% reported starting smoking at 18 or 19 years of age. Only 14% had started daily smoking at ≥20 years of age. Younger age at starting smoking was associated with a lower probability of stopping smoking. For example, 18% of smokers who started at ≤13 years of age had stopped within 10 years, compared with 42% of those who started at ≥20 years of age.[163]

Enforcement activities are important for age-of-purchase laws to be effective. A 2005 Cochrane review on interventions for preventing tobacco sales to minors found that active enforcement, including media coverage of that enforcement, was much more efficacious than educational programs alone.[164] A 2011 comprehensive literature review found that enforcement programs which disrupted the sale of tobacco to minors reduced smoking among youth, whereas merely enacting a law without sufficient enforcement had minimal, if any, impact on youth tobacco use.[165]

10. Flavoring agents, including menthol, should be prohibited in all tobacco products.

Evidence quality: B

Recommendation strength: strong recommendation

Flavoring agents increase the appeal of tobacco products to youth. Tobacco use initiation and progression to tobacco dependence are more common with the use of the flavored products. The only flavoring agent currently allowed in cigarettes is menthol, but small cigars and electronic nicotine delivery systems are not subject to the same regulations and are commonly flavored. Analysis of data from the National Youth Smoking Cessation Survey and the Assessing Hardcore Smoking Survey found that flavored cigarette use was more common among 17-year-olds than among older smokers (23% for 17-year-old smokers vs 9% for 22- to 26-year-old smokers).[166] In the American Legacy Longitudinal Tobacco Use Reduction Study, middle school and high school students were surveyed in 3 waves from 2000 to 2003.[167] Of those who initiated smoking, 39% used menthol cigarettes. This percentage was higher for African-American respondents (52%) compared with all other ethnic groups. Initiating smoking with menthol cigarettes was associated with greater risk of progression to established smoking (OR: 1.80 [95% CI: 1.02–3.16]). An analysis of data from the 2000 and 2002 NYTS found that menthol cigarettes were most popular among younger and newer smokers.[168] Teenagers in middle school who had been smoking for less than 1 year were more likely to smoke menthol cigarettes than middle school students who had been smoking for more than 1 year (62.4% vs 53.3%; $P = .002$). Smokers of menthol cigarettes were significantly less likely to be "seriously thinking of quitting within the next 30 days" (adjusted OR: 0.79 [$P = .012$]). A survey of 1800 adolescents in New York City found that the likelihood of current smoking was greater for teenagers who had tried flavored tobacco products (OR: 2.70 [95% CI: 1.47–4.98]) or menthol cigarettes (OR: 15.16 [95% CI: 8.34–27.57]).[169] A 2010–2011 survey of Canadian high school students found that 52% of these young tobacco consumers reported use of flavored tobacco products.[170]

Recommendations to Protect Children From Tobacco Smoke and Nicotine Exposure

11. Comprehensive smoking bans should be enacted.

Evidence quality: B

Recommendation strength: strong recommendation

The 2006 Report of the Surgeon General concluded, "Workplace smoking restrictions are effective in reducing secondhand smoke

exposure. Total bans on indoor smoking in hospitals, restaurants, bars, and offices substantially reduce secondhand smoke exposure. Exposures of non-smokers to secondhand smoke cannot be controlled by air cleaning or mechanical air exchange. Evidence from multiple peer-reviewed studies shows that smoke-free policies and regulations do not have an adverse economic impact on the hospitality industry."[25] Scotland implemented a comprehensive ban on smoking in public places in March 2006.[57] Before the legislation was implemented, admissions for asthma in children younger than 15 years were increasing at a mean rate of 5.2% per year (95% CI: 3.9–6.6); after implementation, there was a mean reduction in the rate of admissions of 18.2% per year relative to the rate on March 26, 2006 (95% CI: 14.7–21.8). Enactment and enforcement of a law regarding smoke-free public places in Lexington-Fayette County, Kentucky, led to a reduction in emergency department visits for asthma for all ages, with an 18% decline for children and a 24% decline in adults.[171] In Toronto, Ontario, Canada, asthma hospitalizations decreased after implementation of comprehensive smoke-free policies; no such changes were observed in nearby cities that did not implement similar policies, and they were also not observed for common gastrointestinal (ie, non–tobacco-related) conditions.[172]

Smoking in motor vehicles leads to substantial tobacco smoke exposure for nonsmokers. Laws prohibiting smoking in vehicles with children present improved reports of not allowing smoking inside of the car. Studies of tobacco smoking in automobiles found that although open windows in a moving vehicle substantially improve air exchange rates, a significant amount of tobacco smoke (measured as particulate mass concentrations) remains in the vehicle even with the windows open.[173] A study of nonsmokers sitting in a parked car with an open window while a smoker smoked 3 cigarettes over 1 hour found substantially elevated levels of cotinine as well as other tobacco-related toxicants and carcinogens after the in-vehicle tobacco smoke exposure.[174,175] The levels of polycyclic aromatic hydrocarbons in the vehicles after smoking 3 cigarettes with a window open was higher than measurements made in highly polluted urban traffic or in bars and restaurants where smoking was allowed.[176] After passage of legislation in Maine prohibiting smoking in vehicles when a child is present, smoke-free car policies among households with children and a current smoker increased substantially, from 19.2% to 30.7% (Behavioral Risk Factor Surveillance System data).[177]

12. Smoking in multi-unit housing should be prohibited.

Evidence quality: B

Recommendation strength: strong recommendation

Smoking in multi-unit housing exposes children to tobacco smoke. A survey of Minnesota residents of common interest communities (eg, condominiums, cooperatives) found that 28% of households reported secondhand smoke incursion into their unit in the preceding 6 months; 59% of those surveyed said this infiltration bothered them a lot.[178] A survey of 5936 residents of multi-unit housing who participated in the New York State Adult Tobacco Survey between May 2007 and May 2009 found that among respondents with a smoke-free home policy, 46.2% reported secondhand smoke entering their home in the past year, with 9.2% reporting daily incursions.[179] Passive nicotine monitors in low-income multi-unit residences in the greater Boston area detected nicotine in 89% (17 of 19) of nonsmoking homes, indicating secondhand tobacco smoke infiltration.[180] An analysis of data from the 2001–2006 NHANES results for children who lived in nonsmoking residences found greater mean cotinine concentrations among children who lived in apartments than those who lived in attached or detached houses (0.075, 0.053, and 0.031 ng/mL, respectively; $P < .01$).[181]

13. Prohibitions on smoking and use of tobacco products should include prohibitions on use of electronic nicotine delivery systems.

Evidence quality: B

Recommendation strength: strong recommendation

The aerosol emitted from electronic nicotine delivery systems contains toxic and carcinogenic substances in addition to nicotine. A laboratory study of indoor air quality after indoor e-cigarette use by volunteers found substantial amounts of 1,2-propanediol, glycerin, and nicotine as well as high concentrations of particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$) (mean: 197 $\mu g/m^3$). Polyaromatic hydrocarbons (carcinogens) increased by 20% to 147 ng/m^3.[182] An analysis of the content of the aerosol from e-cigarettes found toxic, irritating, and carcinogenic substances, including formaldehyde, acetaldehyde, and acrolein; volatile organic compounds such as toluene and *m,p*-xylene; tobacco-specific nitrosamines; and the heavy metals cadmium, nickel, and lead.[134]

Recommendations to Protect Children From Acute Nicotine Poisoning

14. Children younger than 18 years should be legally prohibited from working on tobacco farms and in tobacco production.

Evidence quality: C

Recommendation strength: recommendation

Green tobacco sickness is a well-described entity. Dermal absorption

of nicotine from moist tobacco plants can lead to symptoms of severe nicotine poisoning, including weakness, headache, nausea, vomiting, dizziness, abdominal cramps, breathing difficulty, pallor, diarrhea, chills, fluctuations in blood pressure or heart rate, seizures, and increased perspiration and excessive salivation.[183] A report using Kentucky Regional Poison Control Center records in 1991 found 104 cases of green tobacco sickness; one-quarter of the reports were in children under 17 years.[184] A case series of 5 children with green tobacco sickness reported symptoms that included a seizure, bradycardia, vomiting, dizziness, headache, pallor, and/or muscle weakness. One child stated that it made him feel, "like I was going to die."[32]

15. Concentrated nicotine solution for electronic nicotine delivery systems should be sold in child-resistant containers with amounts limited to that which would not be lethal to a young child if ingested.

Evidence quality: B

Recommendation strength: strong recommendation

The colorful fruit- and candy-flavored concentrated nicotine solutions for use in electronic nicotine delivery systems can appeal to young children. The oral lethal dose of nicotine by body weight that is estimated to kill 50% of adults is projected to be between 0.8 and 13 mg/kg.[185] Severe nicotine toxicity in children has been reported with doses of nicotine as low as 2 mg. Calls to poison control centers for exposures to electronic nicotine delivery systems (with the majority occurring in children under 5 years) increased from 1 exposure call per month in September 2010 to 215 calls in February 2014.[186] The concentrated nicotine solution used in these devices is a poisoning risk for young children, and at least 1 child has already died of its accidental ingestion.[187]

CONCLUSIONS

Tobacco dependence starts in childhood. The tobacco epidemic takes a substantial toll on children's health, and the harm starts in utero. There is strong evidence to support actions by pediatricians and public policy decision makers that can reduce the development of tobacco dependence and reduce the tobacco smoke exposure of children.

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ABBREVIATIONS

ALL: acute lymphoblastic leukemia
CDC: Centers for Disease Control and Prevention
CI: confidence interval
e-cigarette: electronic cigarette
FDA: US Food and Drug Administration
FTND: Fagerström Test of Nicotine Dependence
NHANES: National Health and Nutrition Examination Survey
NYTS: National Youth Tobacco Survey
OR: odds ratio
s-ICAM1: soluble intercellular adhesion molecule 1
SIDS: sudden infant death syndrome
RSV: respiratory syncytial virus
USPSTF: US Preventive Services Task Force

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Protecting Children From Tobacco, Nicotine, and Tobacco Smoke

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POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

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E-Cigarettes and Similar Devices

Brian P. Jenssen, MD, MSHP, FAAP,[a] Susan C. Walley, MD, FAAP,[b] SECTION ON TOBACCO CONTROL

Electronic cigarettes (e-cigarettes) are the most commonly used tobacco product among youth. The 2016 US Surgeon General's Report on e-cigarette use among youth and young adults concluded that e-cigarettes are unsafe for children and adolescents. Furthermore, strong and consistent evidence finds that children and adolescents who use e-cigarettes are significantly more likely to go on to use traditional cigarettes—a product that kills half its long-term users. E-cigarette manufacturers target children with enticing candy and fruit flavors and use marketing strategies that have been previously successful with traditional cigarettes to attract youth to these products. Numerous toxicants and carcinogens have been found in e-cigarette solutions. Nonusers are involuntarily exposed to the emissions of these devices with secondhand and thirdhand aerosol. To prevent children, adolescents, and young adults from transitioning from e-cigarettes to traditional cigarettes and minimize the potential public health harm from e-cigarette use, there is a critical need for e-cigarette regulation, legislative action, and counterpromotion to protect youth.

DEFINITIONS

- Electronic cigarette (e-cigarette): handheld devices that produce an aerosol from a solution typically containing nicotine, flavoring chemicals, and other additives for inhalation through a mouthpiece by the user (alternative names include "e-cigs, " electronic cigars [or "e-cigars"], electronic nicotine delivery systems, electronic hookah [or "e-hookah"], hookah sticks, personal vaporizers, mechanical mods, vape pens, pod systems, and vaping devices);
- secondhand aerosol: e-cigarette emissions that are discharged into the surrounding environment with e-cigarette use both directly from the e-cigarette and exhaled from the lungs of the user; and
- thirdhand aerosol: e-cigarette emissions that remain on surfaces and in dust after e-cigarette use.

abstract

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Drs Jenssen and Walley conceptualized the manuscript, drafted the initial manuscript, reviewed the final manuscript, and note substantial involvement and contribution to the manuscript; the members of the Section on Tobacco Control Executive Committee reviewed the manuscript, provided critical appraisal, and note substantial involvement and contribution to the manuscript; and all authors approved the final manuscript as submitted.

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BACKGROUND

E-cigarettes are handheld devices that produce an aerosol from a solution typically containing nicotine, flavoring chemicals, and other additives for inhalation through a mouthpiece by the user.[1] There is wide variability in e-cigarette terminology, product design, engineering, and solution components (ie, electronic liquid [e-liquid]).[2] For the purposes of this Policy Statement update,[3] the term "e-cigarettes" encompasses the wide variety of devices that are known as vapes, "mods," tanks, and pod systems, including currently popular brands, such as JUUL.[4] E-cigarettes were introduced to the US market in the mid-2000s, and the design of these products has evolved over time, varying considerably in price, quality, and design.[2,4,5] Early products initially resembled conventional cigarettes, with prefilled cartridges of e-liquid, but quickly developed into tank-style systems, with large refillable cartridges, adding variability in the amount and composition of the e-liquid and potential additives.[1,2] More recent e-cigarette products are more diverse in their design, sometimes resembling common items such as a pen, flashlight, or computer flash drive. In addition to product manufacturers referring to the product as "vaping devices," they are often known as "mods" because of the ability to modify the devices.[1,2] Although commonly referred to as a vapor, the emission from e-cigarettes is most accurately classified as an aerosol, which is a suspension of fine particles in a gas.[6] Nonusers can be exposed involuntarily to the emissions from the exhaled aerosol.[1]

EPIDEMIOLOGY OF YOUTH E-CIGARETTE USE

Use of e-cigarettes increased dramatically over the past decade, making them the most common tobacco product used among youth. Because of the shifting landscape in e-cigarette product design and terminology, combined with different survey definitions, various sources are used to capture data on e-cigarette use. Similar trends have been observed across 3 cross-sectional surveys with data on youth use: the National Youth Tobacco Survey, Monitoring the Future, and the Youth Risk Behavior Surveillance System.[7–9] For the latest data as of 2018, the National Youth Tobacco Survey reported 20.8% of high school students and 4.9% of middle school students currently used e-cigarettes (defined as use of an e-cigarette at least 1 day in the past 30 days)[10]; for 2017, Monitoring the Future reported 17% of 12th graders, 13% of 10th graders, and 7% of eighth graders currently used e-cigarettes[8]; while the Youth Risk Behavior Surveillance System reported 13.2% of high school students currently used e-cigarettes.[9] Current e-cigarette use increased considerably among middle and high school students during 2017-2018 (increasing by 78% from 11.7% to 20.8% among high school students),[10] increasing overall tobacco use and reversing a decline observed in recent years.[7–9] More than 3 million high school students and 570 000 middle school students currently use e-cigarettes.[10] E-cigarette use has been documented as highest among boys, non-Hispanic white youth, and Hispanic youth.[7,11] E-cigarette use is generally greatest among adolescents and young adults and decreases with age in adults. Adult e-cigarette users tend to be previous users of combustible tobacco products, such as traditional cigarettes.[2]

E-CIGARETTE MARKETING, ADVERTISING, AND SALES

E-cigarettes can be purchased in various retail outlets, including vendors that sell tobacco, vape shops, mall kiosks, gas stations, convenience stores, grocery stores, and pharmacies as well as through online/Internet vendors. E-cigarette companies market their products to children and adolescents by promoting flavors and using a wide variety of media channels, approaches used by the tobacco industry to successfully market conventional tobacco products to youth.[1] E-cigarette companies, many of which are owned by major tobacco companies, use promotional tactics including television advertisements targeted to stations with clear youth appeal[12]; advertisements at the point of sale at retail stores[13]; product Web sites and social media[14]; targeted advertisements through search engines and Web sites that are focused on music, entertainment, and sports[15]; celebrity endorsements; and sponsorships and free samples at youth-oriented events.[1] Many of these e-cigarette methods of advertising are illegal for conventional cigarettes precisely because such tactics promote youth initiation and progression to traditional tobacco product use.[16,17]

E-cigarette advertising has effectively reached youth and young adults and is associated with current e-cigarette use. In 2016, 78.2% of middle and high school students (20.5 million youth) were exposed to e-cigarette advertisements from at least 1 source.[18] Exposure to these advertisements increases intention to use e-cigarettes among adolescent nonusers.[19] It is associated with current e-cigarette use,[20] with increasing exposure being associated with increased odds of use.[21,22] The increased use of and exposure to e-cigarettes among youth, combined with dramatic increases in advertising,[23] have serious potential to undermine successful efforts to deglamorize, restrict, and decrease the use of tobacco products.

E-CIGARETTE SOLUTION AND HEALTH EFFECTS

Components of e-cigarette solutions generally include nicotine, flavoring chemicals, and other additives (including those unknown and/or unadvertised to the user).[1] Currently, there are no federal quality standards to ensure the accuracy of e-cigarette constituents as advertised or labeled. Refillable cartridges allow the user to deliver other psychoactive substances, including marijuana.[24] Numerous toxicants and carcinogens have been found in e-cigarette solutions, including aldehydes, tobacco-specific nitrosamines, metals, tobacco alkaloids, and polycyclic aromatic hydrocarbons.[25,26] E-cigarette solution has also been shown to be cytotoxic to human embryonic stem cells.[27]

Nicotine is the major psychoactive component of e-cigarette solution.[1] There are often wide discrepancies between the labeled amount and actual nicotine content within the solution.[2] Reported nicotine concentration in e-cigarette solution ranges widely[28,29] and, depending on how the product is used, can be comparable to or exceed the amount of nicotine in a single conventional cigarette.[30] Nicotine is a highly addictive drug that can have lasting damaging effects on adolescent brain development and has been linked to a variety of adverse health outcomes, especially for the developing fetus.[30,31] Nicotine has neurotoxic effects on the developing brain.[32,33] In early adolescence, executive function and neurocognitive processes in the brain have not fully developed or matured. Adolescents are more likely to engage in experimentation with substances such as cigarettes, and they are also physiologically more vulnerable to addiction.[34] The earlier in childhood an individual uses nicotine-containing products, the stronger the addiction and the more difficult it is to quit.[35] The vast majority of adult smokers initiated tobacco use by 18 years of age.[31]

E-cigarette solutions are often flavored, with thousands of unique flavors advertised.[36,37] Popular options include fruit, candy, and dessert flavors and are appealing to children and youth.[36,37] Availability of flavors is among the most prominently cited reasons for youth e-cigarette use.[38–40] Studies reveal that candy- or fruit-flavored e-cigarettes are more appealing than tobacco flavors to adolescents and young adults.[41,42] Furthermore, adolescents perceive that e-cigarettes with flavors are less harmful than those with tobacco flavors,[41] creating a potential misperception that e-cigarettes with flavors do not contain nicotine.[8] Many of the flavoring chemicals contain aldehydes, known respiratory irritants, in sufficient concentrations to be of toxicologic concern.[37] Flavorings (other than menthol) have been banned in conventional cigarettes since the Family Smoking Prevention and Tobacco Control Act of 2009 because flavoring encourages youth experimentation and regular use and results in addiction.[16,43,44]

Carrier solvents, such as propylene glycol or vegetable glycerin (glycerol), are used in e-cigarette solutions to produce an aerosol that, when heated, simulates conventional cigarette smoke.[1] Although these carrier solvents are used in other settings, there are insufficient data on the health effects of repeated long-term inhalation and exposure to these solvents.[45]

HEALTH EFFECTS OF E-CIGARETTE AEROSOL

The aerosol generated by e-cigarettes is inhaled and then exhaled by the user, and some of the generated aerosol may be discharged directly into the surrounding environment and deposited on surface areas. Bystanders are exposed to this secondhand and thirdhand aerosol in a manner similar to that of secondhand and thirdhand cigarette smoke. Known harmful toxicants and carcinogens have been found in e-cigarette emissions.[1,2] These include polycyclic aromatic hydrocarbons[46] as well as nicotine, volatile organic compounds, and fine and ultrafine particles.[47,48] Metal and silicate particles, some of which are at higher levels than in conventional cigarettes, have been detected in e-cigarette aerosol, resulting from degradation of the metal coil used to heat the solution.[49] There are limited data on the human health effects of e-cigarette emissions. Studies suggest adolescent e-cigarette users are at increased risk of cough, wheeze, and asthma exacerbations.[2]

POISONINGS AND INJURIES

Unintentional exposure to and poisoning from e-cigarette solutions containing nicotine have increased dramatically in the United States since 2011. Although symptoms of acute nicotine toxicity are generally mild and resolve within 12 hours with no treatment, large exposure can be fatal.[50] One child death caused by ingestion of liquid nicotine has been reported in the United States.[51] The Child Nicotine Poisoning Prevention Act of 2015, which was enacted nationally in January 2016, requires containers of liquid nicotine to be in child-resistant packaging; nonetheless, there continue to be thousands of reports of exposure to e-cigarette liquid nicotine yearly to the National Poison Data System.[52] In addition, the lithium-ion batteries used in e-cigarettes have exploded, leading to burns and fires.[2]

E-CIGARETTE USE AND PROGRESSION TO TRADITIONAL CIGARETTE USE

Studies of US youth who use e-cigarettes identify remarkably consistent findings: adolescents and young adults who use e-cigarettes,

compared with those who do not, are at higher risk of transitioning to traditional cigarettes.[2,53] This finding is based on substantial evidence from several separate, well-designed, longitudinal studies.[54–61] Adolescents and young adults (14–30 years of age) who have used e-cigarettes are 3.6 times more likely to report using traditional cigarettes at follow-up compared with those who had not, according to a recent meta-analysis.[53] In addition, adolescents who use e-cigarettes appear to have fewer social and behavioral risk factors than conventional cigarette users.[56–58,60] These findings raise significant concern that e-cigarettes have the potential to addict a new generation to nicotine and tobacco, slowing or reversing the decline in adolescent cigarette smoking that has occurred over the past 20 years.

ROLE IN SMOKING CESSATION AMONG ESTABLISHED SMOKERS

Health claims that e-cigarettes are effective smoking cessation aids are not currently supported by scientific evidence. According to the National Academies of Sciences, Engineering, and Medicine, there is limited evidence regarding the ability of e-cigarettes to promote smoking cessation.[2] In particular, with a limited number of small, randomized-controlled trials, there is insufficient evidence on the effectiveness of e-cigarettes as a cessation aid compared with no treatment or Food and Drug Administration (FDA)–approved smoking-cessation treatments.[2] Studies in real-world clinical settings of smokers interested in quitting reveal that e-cigarette users have lower rates of successful quitting compared with those who never used e-cigarettes.[62] Given the current state of the science, smokers interested in quitting should seek and be referred to evidence-based, safe, and effective treatments, including nicotine replacement therapy, behavioral counseling, and additional pharmacotherapy.[63]

For established smokers, e-cigarettes may reduce health risks for the individual user compared with the risk of continued combustible tobacco use.[2] However, the nuance in this finding must be placed in a larger public health context. Tobacco, when used as intended, causes disease, disability, and death.[31] Operationally, even if e-cigarettes themselves pose less risk to the user than other tobacco products, they still represent a significant public health burden in need of further regulation, particularly if they cause more adolescents and adults to begin harmful combustible tobacco use or prevent fewer people from quitting tobacco use.[2]

FEDERAL, STATE, AND LOCAL E-CIGARETTE REGULATION

The federal government first regulated e-cigarettes in 2016 with the Child Nicotine Poisoning Prevention Act and the FDA Deeming Rule, which extended FDA regulatory authority to all tobacco products, including e-cigarettes.[64] FDA regulations of e-cigarettes now include banning sales to people younger than 18 years, requiring photo identification verification from consumers younger than 27 years, banning free samples and vending machine sales, and including a warning statement on e-cigarette packaging and advertising explaining that nicotine is addictive. Following the FDA Deeming Rule, e-cigarette manufacturers will be required to submit a "premarket review application," which will enable the FDA to assess the public health impact of these products to determine if they can continue to sell them to consumers.[65] However, in 2017, the FDA delayed implementation of the Deeming Rule, allowing e-cigarettes to remain on the market without premarket review until 2022.[66]

Although only the federal government can regulate the manufacture of tobacco products, states have the ability to regulate how tobacco products are sold and used. Many states and localities have enacted e-cigarette regulations, including applying excise taxes to the purchase price, incorporating e-cigarettes in smoke-free–air laws, implementing point-of-sale restrictions, and raising the minimum purchasing age to 21 years.[67] The State Tobacco Activities Tracking and Evaluation system of the Centers for Disease Control and Prevention tracks individual state laws related to e-cigarettes.[68]

Significant gaps remain in e-cigarette regulation. As of this publication date, federal laws and regulations do not appropriately restrict the advertising of e-cigarettes to youth. Furthermore, with no restrictions on flavored e-cigarettes in general, child-friendly flavors are still available and marketed to youth. In addition, the delayed implementation of the FDA Deeming Rule allows all e-cigarettes currently on the market to continue to be marketed and sold to consumers without FDA review through 2022. In 2018, the American Academy of Pediatrics (AAP) and 6 other health groups filed a lawsuit against the FDA,[69] noting that the agency's decision to delay product reviews leaves youth vulnerable to the use of these products and deprives the public of critical health information about e-cigarettes that are already on the market. In 2018, the FDA publicly acknowledged the "epidemic of e-cigarette use among teenagers" and proposed regulatory action[70] in response to data demonstrating rapid acceleration in use.[10] As these usage trends continue, with the rapid rise in popularity among youth of the latest generation of e-cigarettes,[71] the need for federal regulation becomes even

more evident. As of this publication date, the FDA is considering policy actions that could protect youth from e-cigarettes, including newer systems like JUUL.[72]

ONGOING RESEARCH

As the e-cigarette market grows, there is continued need for research to inform regulatory standards and understand the effects of use and exposure across the life span.[2] Additional research is needed to understand the trajectory of addiction among youth and the progression to combustible tobacco products.[1] Studies are needed to determine if and how e-cigarettes may be effective for smoking cessation; these trials must be carefully designed and adequately powered.[2] Finally, research is needed to evaluate effective countermessaging and public health interventions.

Despite the need for ongoing research, the evidence base is sufficient to support immediate regulatory and public health actions. Lessons learned from tobacco control of combustible cigarettes along with available e-cigarette research can be used to build science-based regulations and interventions, including preventing youth access, banning flavors, incorporating e-cigarettes into smoke-free–air laws, regulating marketing practices, and implementing public education programs.[1] It is critical that pediatric health care providers; local, state, and federal governments; and the public health community act immediately to protect youth from these products.

RECOMMENDED ACTIONS FOR THE PEDIATRICIAN

I. Screen for e-cigarette use and exposure and provide prevention counseling in clinical practice.

II. Provide counseling that homes, cars, and places where children and adolescents live, learn, play, work, and visit should have comprehensive tobacco-free bans that include e-cigarettes as well as combustible tobacco products.

III. Do not recommend e-cigarettes as a tobacco-dependence treatment product.

PUBLIC POLICY RECOMMENDATIONS

I. Reduce youth access to e-cigarettes.

a. The FDA should act immediately to regulate e-cigarettes similar to how traditional cigarettes are regulated to protect public health.

b. Ban the sale of e-cigarettes to children and youth younger than 21 years.

c. Ban Internet sales of e-cigarettes and e-cigarette solution.

II. Reduce youth demand for e-cigarettes.

a. Ban all characterizing flavors, including menthol, in e-cigarettes.

b. Ban all e-cigarette product advertising and promotion in forms that are accessible to children and youth.

c. Tax e-cigarettes at comparable rates to those of conventional cigarettes.

III. Incorporate e-cigarettes into current tobacco-free laws and ordinances where children and adolescents live, learn, play, work, and visit.

For more information, including an e-cigarette fact sheet, please refer to the AAP Julius B. Richmond Center of Excellence e-cigarette Web page (https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Richmond-Center/Pages/Electronic-Nicotine-Delivery-Systems.aspx).

For additional AAP clinical and policy recommendations to protect children from the harms of tobacco, see "Clinical Practice Policy to Protect Children From Tobacco, Nicotine, and Tobacco Smoke" (http://pediatrics.aappublications.org/content/early/2015/10/21/peds.2015-3108), and "Public Policy to Protect Children From Tobacco, Nicotine, and Tobacco Smoke" (http://pediatrics.aappublications.org/content/136/5/998).

CONCLUSIONS

E-cigarettes are the most common tobacco product used among youth. E-cigarettes are marketed and advertised by promoting flavors and using a wide variety of media channels and approaches previously used with success by the tobacco industry to market conventional tobacco products to youth. E-cigarette advertising has effectively reached youth and young adults and is associated with current e-cigarette use. Numerous toxicants and carcinogens have been found in e-cigarette solutions. Adolescents and young adults who use e-cigarettes are at high risk of transitioning to traditional cigarettes. The increasing use of e-cigarettes among youth threatens 5 decades of public health gains in successfully deglamorizing, restricting, and decreasing the use of tobacco products. To prevent children, adolescents, and young adults from transitioning from e-cigarettes to traditional cigarettes and to minimize the potential public health harm from e-cigarette use, there is a critical need for e-cigarette regulation, legislative action, and counterpromotion to help youth live tobacco-free lives.

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ABBREVIATIONS

AAP: American Academy of Pediatrics
e-cigarette: electronic cigarette
e-liquid: electronic liquid
FDA: Food and Drug Administration

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Booming Market of Candy-Flavored E-Cigarettes and Cigars Threatens to Hook a New Generation of Kids, New Report Warns

Report Calls on FDA to Prohibit Flavored Tobacco Products, Urges Congress to Reject Proposals to Weaken Agency's Authority

WASHINGTON, DC | March 15, 2017

As fewer kids smoke traditional cigarettes, tobacco companies are enticing them with a booming market of sweet-flavored tobacco products, especially electronic cigarettes and cigars, according to a report issued today by five leading public health organizations.

The report warns that these candy- and fruit-flavored products are putting a new generation of kids at risk of nicotine addiction and the serious health harms that result from tobacco use. It calls on the U.S. Food and Drug Administration (FDA) to prohibit all flavored tobacco products and urges Congress to reject legislation that would weaken the FDA's authority, especially over e-cigarettes and cigars.

While a 2009 federal law, the Family Smoking Prevention and Tobacco Control Act, prohibited candy- and fruit-flavored cigarettes, manufacturers in recent years have introduced a fast-growing assortment of flavored non-cigarette tobacco products. Studies show:

- E-cigarettes are available in more than 7,700 flavors, with hundreds more added every month.
- The number of unique cigar flavor names more than doubled from 2008 to 2015, from 108 to 250.
- Sales of flavored cigars have increased by nearly 50 percent since 2008, and flavored cigars made up more than half (52.1 percent) of the U.S. cigar market in 2015.

The report, titled "The Flavor Trap: How Tobacco Companies Are Luring Kids with Candy-Flavored E-Cigarettes and Cigars," was issued by the Campaign for Tobacco-Free Kids, American Academy of Pediatrics, American Cancer Society Cancer Action Network, American Heart Association and American Lung Association.

Sweet flavors make the products "seem like they belong in a candy store or ice cream parlor," the report states. Flavor examples cited include gummy bear, cotton candy, peanut butter cup, cookies ‘n cream and pop rocks for e-cigarettes and chocolate, wild berry, watermelon, lemonade and cherry dynamite for cigars. One study found over 20 different types of unicorn-themed e-cigarette flavors, such as Unicorn Puke, often paired with cartoon imagery.

Flavors have helped fuel the popularity of these products among kids. Youth use of e-cigarettes soared from 2011 to 2015, surpassing use of regular cigarettes, and more high school boys now smoke cigars than cigarettes, surveys show. A government study found that 81 percent of kids who have ever used tobacco products started with a flavored product, including 81 percent who have ever tried e-cigarettes and 65 percent who have ever tried cigars. Youth also cite flavors as a major reason for their current use of non-cigarette tobacco products, with 81.5 percent of youth e-cigarette users and 73.8 percent of youth cigar users saying they used the products "because they come in flavors I like." Research has found that flavored tobacco products are more likely to be used by youth and young adults than by older tobacco users.

"Tobacco products simply shouldn't be sold in flavors that appeal to kids, let alone in thousands of flavors that make them seem fun and harmless," said Matthew L. Myers, President of the Campaign for Tobacco-Free Kids. "When you see a gummy bear e-cigarette or a cherry dynamite cigar, there's no doubt these products are aimed at kids. Our report makes abundantly clear why Congress must reject the proposals to weaken FDA oversight of products like e-cigarettes and cigars, including the flavored products that have flooded the market in recent years. Congress shouldn't be helping tobacco companies market candy-flavored products to kids."

In August 2016, the FDA implemented a new rule extending its jurisdiction to e-cigarettes, cigars and other previously unregulated tobacco products. Two bills before Congress would greatly weaken the FDA's authority:

- One bill would limit FDA oversight of e-cigarettes and cigars already on the market, including the many flavored products introduced in recent years, and exempt these products from a critical scientific review to determine their impact on public health, including their appeal to kids. This bill would make it much harder for the FDA to remove flavored products from the market and, by making the current products the industry standard, much easier for manufacturers to introduce new ones in the future.
- A second bill would exempt what the tobacco industry calls "traditional large and premium cigars," but defines such cigars so broadly that it could also exempt some cheap, machine-made, flavored cigars that are widely used by kids.

Instead of weakening the FDA's authority, today's report calls on the FDA to prohibit all flavored tobacco products, finding that "there is more than sufficient scientific evidence

to support such a prohibition."

While the U.S. has made tremendous progress in reducing youth cigarette smoking, current e-cigarette use among high school students increased from 1.5 percent in 2011 to 16 percent in 2015, according to the government's National Youth Tobacco Survey, which has tracked youth e-cigarette use the longest of any survey. Another national survey, the 2016 Monitoring the Future survey, shows the first evidence of a decline in youth use of e-cigarettes, but e-cigarettes continue to be the most-used tobacco product among kids. Recent surveys have also shown that more high school boys now smoke cigars than cigarettes – 14 percent vs. 11.8 percent in the 2015 Youth Risk Behavior Survey.

"As pediatricians, we do everything in our power to ensure that all children have the opportunity to grow up healthy and free from addiction to tobacco and nicotine. Addressing the threat of tobacco, no matter the form it takes, is imperative to meet that goal," said American Academy of Pediatrics President Fernando Stein, MD, FAAP. "Coming in flavors like cotton candy and gummy bear, it is no surprise that e-cigarettes and their highly-concentrated liquid nicotine refills have become popular among youth. The Academy will continue to urge Congress and the FDA to support and strengthen efforts that protect children from dangerous tobacco products."

"Thousands of fruit- and candy-flavored e-cigarettes, cigars and other tobacco products continue to be dangerously attractive and popular among youth, "said Chris Hansen, president of the American Cancer Society Cancer Action Network. "Preserving the FDA's authority to regulate all tobacco products is crucial to protecting the health and safety of the American people and preventing our kids from starting on a path to tobacco addiction."

"As this new report reinforces, the tobacco industry is relentless in its pursuit to recruit the next generation of addicted users, and at an early age – exploiting new technology and appealing flavors to seal their deadly deal," said Nancy Brown, CEO of the American Heart Association. "And young people are not the only ones being manipulated. Flavored tobacco attracts people of all ages, burdening users for a lifetime of health consequences like cardiovascular disease. Proposed legislation threatens to weaken public health protections for these newly deemed tobacco products, including flavored cigars, making it easier for manufacturers to continue targeting children and adults alike

with tempting flavors. This is unconscionable. Congress must prioritize protecting Americans, especially children, from taking up this undeniably deadly habit. "

"As this report clearly demonstrates, alarmingly, kid-friendly flavors like gummy bear, cotton candy, chocolate and cherry dynamite are enticing our children to use tobacco products, including e-cigarettes and cigars, and setting them up for a lifetime of addiction to tobacco products," said American Lung Association National President and CEO Harold P. Wimmer. "Congress needs to protect kids from these highly addictive and harmful products, not give the tobacco industry a sweetheart deal by allowing these products to be grandfathered in and bypass FDA review."

Related Materials

Full report (PDF)

Downloadable charts and photos

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About the American Lung Association
The American Lung Association is the leading organization working to save lives by improving lung health and preventing lung disease through education, advocacy and research. The work of the American Lung Association is focused on four strategic imperatives: to defeat lung cancer; to champion clean air for all; to improve the quality of life for those with lung disease and their families; and to create a tobacco-free future. For more information about the American Lung Association, a holder of the coveted 4-star rating from Charity Navigator and a Gold-Level GuideStar Member, or to support the work it does, call 1-800-LUNGUSA (1-800-586-4872) or visit: Lung.org.

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