Tobacco in the 21st Century

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Practice Gap

Although there is increasing understanding that cigarette smoking and secondhand smoke exposure are significant health risks to children, adolescents continue to start smoking, and children are still exposed to secondhand smoke. To add to this, companies are finding more novel ways to market tobacco products, including electronic cigarettes and dissolvable tobacco products. Pediatricians should understand the consequences of tobacco smoke exposure and the use of emerging products and be able to screen and counsel families about their exposure.

Objectives

After completing this article, readers should be able to:

1. Identify the prevalence of secondhand smoke exposure among children in the United States.
2. Describe the health effects of cigarette smoking.
3. Understand the effects of secondhand smoke on children’s health and behavior.
4. Describe the role of the pediatrician in helping parents quit smoking and how to help parents access pharmacotherapy.
5. Understand the effect and use of noncigarette tobacco products.

CASE

Eliza is a 5-year-old girl whose mother brings her to the office for wheezing. She has been coughing and having some upper respiratory tract congestion for 3 days, but this morning she developed increased wheezing and shortness of breath. Her mother has been giving her albuterol, which hasn’t seemed to help. She has a diagnosis of asthma and is taking an inhaled corticosteroid, which her mother says she has been using twice a day via a spacer, as directed at her last visit.

Eliza was hospitalized at age 8 months with bronchiolitis, and since then she has been to the emergency department 6 times for exacerbations. She had to be hospitalized once but not in the intensive care unit. She has no other medical problems aside from the asthma diagnosis.

Eliza lives with her mother, father, and 6-month-old sister. They have 2 cats and a woodstove. Eliza’s mother smokes cigarettes but only outside. Eliza’s father does...

AUTHOR DISCLOSURE

Dr Wilson has disclosed no financial relationships relevant to this article. This commentary does not contain a discussion of an unapproved/investigative use of a commercial product/device.

ABBREVIATIONS

CEASE Clinical Effort Against Secondhand Smoke Exposure
FDA Food and Drug Administration
NRT nicotine replacement therapy
SHS secondhand smoke
SIDS sudden infant death syndrome
not smoke cigarettes, but he does use chewing tobacco. Eliza’s grandparents both smoke, and she stays with them 2 days a week while her parents are working.

INTRODUCTION

Tobacco use remains a major cause of preventable morbidity and mortality in the United States. Although the overall smoking rate has decreased in the past 20 years, it has not decreased in the last 5 years. In 2009, 20.6% of adults were still current smokers, and 54% of children ages 3 to 11 years had biological evidence of tobacco smoke exposure. (1) Secondhand smoke (SHS) exposure has a significant effect on the health of children and may contribute to smoking initiation in adolescence.

Although cigarette smoking remains the most common method of using tobacco, other forms of tobacco are increasing in popularity, including new, and as of yet, unregulated products, such as electronic cigarettes, Snus (moist tobacco powder), and dissolvables. Lifetime prevalence of electronic cigarette use has increased from 1.8% in 2010 to 10.6% in 2012; this prevalence is only likely to increase as tobacco companies develop and market their own electronic cigarette products. In addition, chewing tobacco remains a popular form of tobacco, especially in some states, including Wyoming, West Virginia, and Oklahoma, where more than a quarter of adults use smokeless tobacco. (6) Smoking and SHS exposure remain a major issue among adults and children of lower socioeconomic status.

Pediatricians are often the most consistent medical practitioners for families, especially for parents with fewer resources who may be uninsured. Pediatricians can play an important role in educating families about the dangers of smoking and SHS, advising adolescents on why never smoking is so important, and helping parents and teens quit smoking if they have started.

This article reviews the consequences of smoking and exposure to SHS and how pediatricians can use the US Public Health Services guidelines and the National Cancer Institute recommendations to help parents quit smoking and reduce their children’s exposure. We also review what we know about the effects of noncigarette tobacco products, including emerging products, such as electronic cigarettes, which still contain nicotine and are addictive.

EPIDEMIOLOGY OF SMOKING AND SHS EXPOSURE

Data from the National Health Interview Survey in 2009 found that 20.6% of adults were current smokers; 78% reported smoking every day. (2) Smoking is more common among men than women and among non-Hispanic whites and blacks. More than 30% of those below the poverty line reported smoking, compared with 19.4% of those at or above the poverty level. Almost 20% of US high school students report having smoked a cigarette in the last 30 days; because more than 80% of adult established smokers started smoking before age 18 years, we are not likely to see a significant decrease in smoking prevalence in the near future.

The National Health and Nutrition Examinations Survey measures biological samples for the presence of cotinine, a metabolite of nicotine, to determine SHS exposure. (1) Between 1999 and 2008, the prevalence of SHS exposure among US nonsmokers ages 3 and older decreased, from 52.5% to 40.1%; however, children remain the most highly exposed group, with 54% of children in 2009 having evidence of SHS exposure. Children were also more likely to live in a home where someone smoked; 18.1% of children ages 3 to 11 years and 17.1% of youth ages 12 to 19 years lived with a smoker. Once again, exposure of nonsmokers to SHS was highest in those with the lowest socioeconomic status.

OTHER SOURCES OF SMOKE EXPOSURE IN THE HOME

Cigarette smoke is not the only source of respiratory irritation in the home, and cigarette smoke can combine with other sources to worsen respiratory symptoms. In rural settings in particular, some homes are still heated with wood stoves, which can result in strong particulate burden, thereby worsening asthma and other respiratory symptoms. Any fireplace can provide enough smoke to exacerbate asthma, even when not used to heat the home, and coal stoves seem to provide a particularly high risk. Even use of a gas-fueled stove is associated with increased risk in children. Other potential respiratory irritants in the home include hairspray and cooking sprays. Some respiratory irritants found in the home are well-known allergens, including animal dander, cockroach feces, and mold. Children at high risk for respiratory illness, asthma, and allergies should be protected from exposure to all these exposures. In addition, children in multiunit housing may be exposed to SHS that drifts from other apartments; it may be especially important to screen for multiunit housing in children with difficult to control respiratory illness and no obvious exposures. In addition, there are resources for families who want to advocate for their rights to live in a smoke-free environment and happen to live in multiunit housing where smoking is allowed. Further research is needed to determine the effect of tobacco smoke incursions on the respiratory health of children.
Thirdhand Smoke
As we have learned more about how tobacco smoke can accumulate on surfaces and in the air, the concept of thirdhand smoke is becoming better understood. When a cigarette is extinguished, components of the smoke remain in the air and on surfaces. (3) The tar in cigarette smoke accumulates on walls and floors, and the particulates and chemicals in cigarette smoke land on furniture, only to become airborne when someone sits down. Infants may be at particular risk as they crawl on the floor and then ingest the residue from their hands. (4) Many parents believe that they are completely protecting their children when they smoke outside; however, studies suggest that children of parents who smoke outside still have elevated cotinine levels, at levels associated with increased risk of disease. Many pediatricians encourage parents to use separate “smoking jackets” or clothes when smoking; although there are no studies that report that this is effective, it is probably better than no protective measures. However, parents should be cautioned that by taking these measures they might not completely protect their child. In addition, parents should always wash their hands well after smoking before handling their child. More research is needed to determine whether there are effective ways to mitigate exposure for parents who continue to smoke.

IMPACT OF SHS EXPOSURE
In 2006, the US Surgeon General published the report The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General and followed this with Children and Secondhand Smoke Exposure—Excerpts from The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General, 2007. (5) The first report outlines the overwhelming evidence for the role of SHS in causing disease and disability in nonsmokers, and the second report details the effect of SHS on children in particular. In the second report, the US Surgeon General concludes that completely smoke-free homes and cars are the only way to protect children from the dangers of SHS. Exposure to SHS postnatally is dangerous to the health of children (as is prenatal exposure, which is discussed below).

Respiratory System
The US Surgeon General found enough evidence to determine that SHS is causally related to lower respiratory tract infection in children and that the greatest risk is when the mother smokes. SHS increases the severity of illness and the duration of symptoms. A causal relationship also exists between SHS and acute and chronic middle ear infection, as well as middle ear effusion. Parents of children with recurrent or chronic acute otitis media should be advised of the relationship between ear infections and SHS and be encouraged to quit smoking or create smoke-free home rules. SHS increases the likelihood that a child will develop asthma, and once the child has developed the disease, SHS causes and worsens exacerbations.

Sudden Infant Death Syndrome
The US Surgeon General’s report concluded that there is sufficient evidence for a causal relationship between sudden infant death syndrome (SIDS) and SHS exposure. (5)

Behavior and Cognition
SHS has been associated with decreased math design and block scores, and the greatest associated decreases occurred at the lowest blood levels of cotinine, levels that are more likely associated with smoke exposure from a parent smoking outside. SHS is also associated with attention-deficit/hyperactivity disorder and conduct disorder, as well as sleep problems in children. (5)

PHYSIOLOGIC EFFECTS OF CIGARETTE SMOKING
The US Surgeon General’s report 2010: How Tobacco Smoke Causes Disease contains a detailed review of the pathophysiology of smoking and tobacco smoke exposure and their relationship to the many associated conditions. (6) The findings are summarized here. In general, susceptibility to tobacco-related disease is variable, and we are only starting to understand the complicated genetics behind disease development and the propensity to develop nicotine addiction.

Smoking a cigarette has an immediate effect on most organ systems and serious long-term consequences with use. (6) The smoke inhaled into the lungs contains thousands of chemicals, many carcinogenic and many that are strong oxidants. In addition, the smoke contains particulates, which are physically irritating to delicate lung tissue. Initially, inhaling tobacco smoke causes an increase in heart rate and blood pressure as nicotine stimulates the sympathetic nervous system. As the lungs react to the presence of irritants, the body mounts a local inflammatory response, sending a rush of inflammatory cytokines to the site of the “invasion.” For many people the inflammatory cytokines attract primarily neutrophils and macrophages, but for some the inflammatory response becomes more atopic. There is a higher ratio of Th2 cytokines present, which recruits more eosinophils and can provoke acute asthma exacerbations or allergic responses. As the local inflammatory response continues, systemic inflammation follows.
Even brief exposure to tobacco smoke can result in measurable endothelial dysfunction. (6)

In the long term, smoking tobacco causes cancer—cancers of not only the lung, mouth, and upper airways but also the pancreas, bladder, kidney, and cervix, as well as acute myeloid leukemia. Tobacco smoke contains many known carcinogens, including heterocyclic compounds, polycyclic aromatic hydrocarbons, and N-nitrosamines; 15 of the compounds found in tobacco smoke are labeled grade 1 human carcinogens; the others have been found to be carcinogenic in animal models. (6)

Smoking tobacco also causes heart disease through a variety of mechanisms. The chronic sympathomimetic effects of nicotine may overstimulate the circulatory system, and the carbon monoxide exposure increases the effects of peripheral vascular disease and ischemia. The heavy dose of oxidizing agents in tobacco smoke also contributes to multiple cardiovascular disease risk factors, including atherosclerosis, dyslipidemia, endothelial dysfunction, platelet activation, and inflammation. (6)

Tobacco smoke has a marked effect on long-term lung health and plays a significant role in the development of chronic obstructive pulmonary disease, emphysema, chronic bronchitis, and pulmonary hypertension. One primary mechanism for lung injury is exposure to reactive oxygen species with ensuing inflammation. Much of the tobacco smoke–related lung injury is irreparable; however, quitting smoking improves outcomes, especially in early disease. (6)

Smoking cigarettes has significant effects on the reproductive system and on pregnancy—from menstrual irregularities to infertility and spontaneous abortion. Other associated pregnancy complications include placenta previa, placental abruption, and ectopic pregnancy. Several studies have also found decreased sperm count in men who smoke tobacco. Infants exposed to tobacco smoke in utero are more likely to have low birth weight and be premature, which also may contribute to the higher infant mortality found in neonates of mothers who smoked during pregnancy. There is a higher risk of SIDS in infants exposed in utero on top of the increased risk of SIDS from postnatal exposure. (6)

**PHYSIOLOGIC EFFECTS OF CHEWING TOBACCO**

Chewing tobacco or “snuff” also has significant negative health consequences. (6) Chewing tobacco contains a similar level of nicotine to cigarettes and thus has similar sympathomimetic effects. There is a similar risk for myocardial infarction and stroke for those who chew tobacco as those who smoke and an elevated risk for oral and throat cancers.

**BEHAVIORAL CONSEQUENCES OF TOBACCO USE AND ABUSE AND POTENTIAL FOR PHYSIOLOGIC ADDICTION**

Nicotine is highly addictive and has profound effects on the brain, especially during development. (6) Tobacco addiction is similar both pharmacologically and behaviorally to cocaine or heroin addiction and has both physiologic and psychological components. There is evidence that teenagers become addicted more quickly than adults, which may explain why most adult smokers started before age 21 years. Adolescents may exhibit nicotine dependence when smoking only 2 cigarettes per week. In fact, there is a suggestion that SHS is associated with symptoms of nicotine addiction before ever having a cigarette. Some children with SHS exposure have cotinine levels consistent with active smoking, but we need more studies to determine how SHS exposure leads to smoking in these children.

**TREATMENT**

The 2004 *Pediatrics in Review* article “Tobacco Prevention and Cessation in Pediatric Patients” by Deepa Camenga and Jonathan Klein details the treatment of tobacco dependence for parents and teenagers; this review provides an update. (7)

The US Public Health Service, the National Cancer Institute, and the National Heart, Lung, and Blood Institute have issued recommendations for treating tobacco use and dependence that are based on the 5 A’s intervention model. (8) The 5 A’s are Ask, Assess, Advise, Assist, and Arrange; the 5 A’s can also be adapted to 2 A’s and an R (Ask, Assist, and Refer). (9) The American Academy of Pediatrics recommends that pediatricians address tobacco dependence among parents and teen patients by asking all patients and parents about family use of tobacco; (10) however, parents report being asked about smoking status half of the time and fewer than half of smokers were advised to quit. Parents, even those who smoke, report that they expect their child’s pediatrician to ask about their smoking.

The Clinical Effort Against Secondhand Smoke Exposure (CEASE) uses the Ask, Assist, and Refer model in an effort to expand comprehensive parent tobacco dependence treatment to pediatric practices across the United States. (11) CEASE has been effective at implementing the intervention into practice and includes many practice tools.

Counseling is the cornerstone of tobacco dependence treatment. Brief counseling by pediatricians can be helpful in initiating and maintaining cessation, and pediatricians who are caring for infants have multiple opportunities in the first year of life to see the child and provide ongoing counseling for the parents. Some offices also offer counseling, such as motivational interviewing, which may be
performed by other practitioners, such as social workers or nurses. This is somewhat more labor intensive but can provide an alternative to pediatrician counseling in busy practices. Pediatricians should always at least ask and advise the parents of their patients about smoking, even if someone else provides the intervention. (10) Tobacco quitlines are an evidence-based intervention for smokers, and quitlines are available nationally. Although the quitlines vary in what they offer, all provide assessment of smoking behaviors, counseling on smoking cessation, and follow-up calls to assess progress and support cessation. There is some evidence that the new texting-based programs for tobacco cessation are helpful.

Pharmacotherapy doubles the chances that a smoker will quit. (9) There are several forms of pharmacotherapy commonly used in smoking cessation. The most common is nicotine replacement therapy (NRT). NRT comes in multiple forms—gum, lozenges, and slow-release patches that are available over the counter and nasal sprays and inhalers that are available by prescription. The use of 2 NRT products can increase the likelihood of success: the patch and the gum or lozenge for breakthrough cravings. The most common reason for NRT treatment failure is underdosing. The Food and Drug Administration (FDA) has also approved NRT for use in reducing smoking, as well as cessation, and can be recommended as a way to postpone the need for a cigarette. This may be especially helpful for parents of hospitalized children who do not want to go outside to smoke.

There are 2 other prescription-only products that have been reported to be effective for tobacco cessation. Varenicline is a nicotinic receptor partial agonist that decreases the cravings for tobacco, with an almost 25% abstinence rate at 1 year. It is effective but carries a black-box warning for the potential association with depression and suicidal thoughts. Bupropion, a dopamine reuptake inhibitor, is slightly less effective, with a 15% abstinence rate at 1 year, but it is also an antidepressant and can be effective for some patients.

The CEASE program has been effective at providing support for pediatricians to prescribe smoking cessation medications, especially NRT, to the parents of their patients. (11) Similar to the common practice of giving influenza vaccinations to parents or prescribing azithromycin to parents when there is a household exposure, prescribing NRT is legal and ethical. Pediatricians may be more comfortable prescribing the over-the-counter forms of NRT, which may be covered under insurance if prescribed; however, some pediatricians prescribe bupropion and varenicline to their patients’ parents, with good success.

### EMERGING PRODUCTS

New tobacco products have been coming to the market in the past few years. Although these products are often marketed as “reduced harm” and may provide an opportunity for SHS-free tobacco use for parents, there is concern because of the lack of regulation and standardization and the potential for modeling and use by youth and nonsmokers. These products also do not currently come under regulatory authority of the FDA, and thus their ingredients are unregulated. In addition, they are often available in flavors that appeal to youth.

#### Noncigarette Combustible Tobacco

A cigarette is a specifically defined product that has a paper wrapper. Cigars and cigarillos are similar to cigarettes in that they include tobacco leaf in a wrapper. However, the wrapper in this case is tobacco leaf or tobacco-based paper; thus, they do not come under the FDA regulatory authority. Cigarillos or little cigars are sold in a variety of flavors and are increasingly used by adolescents and young adults. Hookah is another tobacco product that is increasing in popularity with youth. Hookah uses a water pipe to inhale tobacco smoke, usually in a social situation; hookah bars are now popular around college campuses. Hookah is also often flavored, and in addition to the risks of the tobacco smoke and nicotine, the shared use of a mouthpiece can transmit viruses and other infectious diseases.

#### Electronic Cigarettes

Electronic cigarettes are also known as e-cigs, electronic nicotine delivery systems, or personal vaporizers; their use is often referred to as vaping. Electronic cigarettes are battery powered and deliver a nicotine-containing solution through a cylinder where the liquid is vaporized, allowing the
delivery of nicotine vapor into the lungs. This action mimics the use of cigarettes. The cartridges that contain the nicotine solution in some models are refillable, and some people use these devices to vaporize other solutions, such as hash oil. Currently, there is no regulation of electronic cigarettes and no requirement for companies to disclose the chemicals used in the liquid, the nicotine concentration, or the vaporization methods. In addition, companies are marketing electronic cigarettes with flavors that appeal to teens and young adults, and there is concern that electronic cigarettes will be used not as cessation devices but as a way to initiate nonsmokers into nicotine addiction with a product that does not have the noxious effects of smoking tobacco. The FDA recently announced their intention to regulate electronic cigarettes, as well as other emerging tobacco products, but these regulations will be limited and will not include banning flavors or the limiting advertisement.

Studies are conflicting about the effectiveness of electronic cigarettes for cessation; more studies are needed to determine whether these can be a tool for parents to use. A few studies have suggested that the vapor exhaled from electronic cigarettes may contain nicotine or other chemicals. In addition, the refill cartridges for some brands contain enough nicotine in solution to kill a child if ingested; thus, parents should be strongly cautioned to keep electronic cigarettes (and all tobacco products) completely out of the reach of children. Pediatricians should also counsel parents that the use of electronic cigarettes may model smoking behavior for children and adolescents and that they should only use electronic cigarettes when away from their kids. They should also counsel adolescent patients against the use of any nicotine-containing products, reduced harm or not.

Dissolvable Tobacco Products
Dissolvable tobacco products are made by grinding up tobacco, often with flavorings, to create a tobacco product that dissolves in the mouth. They are shaped into orbs, which resemble Tic-Tacs; sticks, which resemble toothpicks; and strips, which resemble breath strips. Pediatricians should warn parents that these products look like candy and may appeal to small children.

Snus
Snus are moistened tobacco that is contained in a pouch and kept refrigerated; unlike chewing tobacco, use of snus does not require spitting and so is more suited to use in places where smoking is not allowed. These are modeled after a product that is often used for cessation in Sweden; there is no evidence yet that this is an effective cessation product in the US market.

Tobacco use in the 21st century has changed significantly. Although cigarette smoking is decreasing among Americans, the health consequences of SHS exposure, especially for children, persist, and new and unregulated tobacco products are being introduced to the market. Pediatricians need to stay aware of the persistent danger posed by cigarettes and other tobacco products to their patients and to ask their patients and families about tobacco use, advise them about the risks, and work with them to quit smoking, eliminate SHS, and avoid the use of unregulated tobacco products.

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Summary
- On the basis of biological samples of population data, more than half of US children continue to have exposure to secondhand smoke. (1)
- On the basis of overwhelming evidence from epidemiologic and basic science research, exposure to tobacco smoke prenatally, and in childhood, causes respiratory illness in children. (2)
- On the basis of overwhelming evidence from epidemiologic and basic science research, smoking tobacco causes cancer and heart disease. (2)
- On the basis of observational studies, children’s exposure to tobacco smoke is also associated with nonrespiratory illnesses, such as sudden infant death syndrome, attention-deficit/hyperactivity disorder, and decreased cognitive scores. (2)
- On the basis of randomized controlled trials in adults, US Public Health Service guidelines, and results of the Clinical Effort Against Secondhand Smoke Exposure study, parents should be asked about their children’s exposure to secondhand smoke at each visit and offered assistance with quitting or referral to the quitline if they smoke. (3)(4)
Key References:


Parent Resources from the AAP at HealthyChildren.org

- English: http://www.healthychildren.org/English/health-issues/conditions/tobacco/Pages/Smoke-Free-Laws.aspx
- English: http://www.healthychildren.org/English/health-issues/conditions/tobacco/Pages/Quit-Resources-for-Smokers.aspx
- Spanish: http://www.healthychildren.org/spanish/health-issues/conditions/tobacco/Paginas/Quit-Resources-for-Smokers.aspx
PIR Quiz

1. You are providing prenatal counseling to an expectant mother who is a past smoker. She gave up smoking for her pregnancy but is looking forward to “lighting up” after she gives birth. If the infant is exposed to secondhand smoke after birth, he/she will be at increased risk of which of the following conditions?
   A. Allergic colitis.
   B. Gastroesophageal reflux.
   C. Sleep apnea.
   D. Sudden infant death syndrome.
   E. Urinary tract infection.

2. You are discussing the epidemiology of smoking with a group of medical students. Which of the following statements about smoking is true?
   A. Approximately 40% of adults living in the United States currently smoke tobacco.
   B. Approximately 50% of children have evidence of secondhand smoke exposure.
   C. A tobacco smoker is more likely to continue smoking if he/she started after age 18 years.
   D. Hispanic people are at highest risk to be smokers.
   E. Women are more likely to smoke than men.

3. You are seeing an 18-year-old male high school senior in your clinic. He has been smoking for 2 years, is interested in quitting, but continues to smoke despite counseling. He is interested in receiving pharmacotherapy to help him quit. Which of the following agents has a role in smoking cessation?
   A. Bupropion.
   B. Clonidine.
   C. Fluoxetine.
   D. Nortriptyline.
   E. Zolmitriptan.

4. A 15-year-old girl comes in for a counseling visit and states that several of her friends have encouraged her to try “e-cigarettes.” You counsel her on the risks of such products. Which of following statements about e-cigarettes is true?
   A. E-cigarettes are not addictive.
   B. E-cigarettes cause emphysema.
   C. E-cigarettes cause heart disease.
   D. E-cigarettes contain nicotine.
   E. E-cigarettes contain tobacco.

5. The primary cornerstone of tobacco dependence treatment is?
   A. Counseling by a health care professional.
   B. E-cigarettes.
   C. Nicotine replacement therapy.
   D. Tobacco quitlines.
   E. Varenicline.
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