adolescents may experience short-term respiratory effects from vaping, such as coughing and wheezing, but studies are needed to determine long-term effects on their hearts and lungs, according to a recent scientific statement from the American Heart Association (AHA).

The statement includes recommendations to curb adolescent vaping, which is the most popular way youth consume nicotine in the US. It comes at a time of increased scrutiny of vaping devices, also known as e-cigarettes. The US Food and Drug Administration (FDA) banned sales of e-cigarettes and other electronic nicotine delivery system (ENDS) products to people younger than 18 years in 2016. In 2019 the federal minimum age for all tobacco product sales, including e-cigarettes, was raised from 18 to 21. And as of 2021, manufacturers of new tobacco products including ENDS products must demonstrate that their devices offer public health benefits as part of their marketing application with the FDA. The agency banned the popular JUUL Labs products this past June but now allows sales while it conducts a further scientific review.

Why It’s Important
Clinicians, regulators, and parents want to know more about the health effects of vaping, which has exploded in popularity among adolescents over the past decade—especially after “pod mods” were introduced in 2017. These vapes look like USB drives and contain high nicotine content e-liquids. At e-cigarettes’ peak popularity, in 2019, about 27% of high school students and about 11% of middle school students used them, according to the Centers for Disease Control and Prevention.

Most studies of e-cigarettes’ health effects have involved adults, who are often former traditional cigarette smokers with underlying cardiopulmonary risks, according to the AHA statement published in Circulation Research. In contrast, most new users of e-cigarettes are adolescents who have never inhaled nicotine before.

“Adolescents who begin vaping now may become lifelong tobacco or nicotine users, and it is currently unknown what diseases will develop over a lifetime of vaping,” the authors wrote in the statement.

The Design
The authors summarized the limited scientific literature on the cardiopulmonary—or heart and lung—associations of vaping among adolescents. They then compared this research with studies involving adults to provide background on the overall cardiopulmonary risks of vaping. They also summarized underlying drivers of adolescent vaping including e-cigarette flavors, advertising in traditional and online media, and the easy concealment of vaping devices made to appeal to tech-savvy teens. They proposed regulations for policy makers to prevent vaping among adolescents.

What We’ve Learned About Adolescent Vaping and Health
“Shockingly, there is not a lot of data,” Loren Wold, PhD, the statement’s senior author and professor of medicine and nursing at The Ohio State University in Columbus, said in a phone interview. Here’s what the statement’s writing group learned:

- Respiratory associations: A handful of studies have found associations between e-cigarette use and asthma, wheeze, or chronic bronchitic symptoms—chronic cough, phlegm, or bronchitis—among adolescents.
- Cardiovascular associations: To date, studies have not investigated cardiac issues among adolescents who vaped.

According to Wold, whose lab investigates cardiac disease triggers including e-cigarette exposure, studies involving adults have not shown cardiac issues with vaping, with the exception of some arrhythmias. “However, in adults it has been shown that lung issues are persistent, that start with coughing/wheezing and progress to reductions in lung capacity and compliance,” he wrote in an email.

What About e-Liquids?
e-Liquids, also called e-juice, typically include nicotine, propylene glycol, and flavors. The toxicity of e-liquid vapors remains poorly understood. Heating or combusting chemicals as part of a vape device raises questions about their potential toxicity, Wold said.

With the exception of nicotine, flavoring ingredients in e-liquids fall under the
category of generally recognized as safe (GRAS) by the FDA. But most chemicals on this list were intended for food consumption and have not been tested for their toxicity when inhaled. Their effect on lungs is therefore unknown, according to the statement.

What’s more, due to the proprietary nature of these products, the concentration of e-liquid ingredients aside from nicotine is often unknown. Wold noted that companies routinely alter their e-liquid compositions. The dangers of vaping certain ingredients were highlighted in 2019 when several outbreaks of a new lung disease named e-cigarette, or vaping, product use–associated lung injury—EVALI—were linked to vaping tetrahydrocannabinol, or THC, with vitamin E acetate.

The Limitations

E-cigarettes have only been on the US market since 2007, and Wold said the long-term health implications of these devices are unknown. Developing animal models of adolescent vaping could help answer these questions because enrolling minors in clinical vaping studies is difficult. Wold pointed to his own recent study in Circulation, published after the AHA scientific statement went to press, that found that adolescent mice exposed to e-cigarette vapor exhibited cardiovascular dysfunction into adulthood.

In an interview, Neal L. Benowitz, MD, who was not involved with the AHA statement but wrote a commentary about it, said that although regular vaping among adolescents could be harmful, most kids who vape do so fewer than 10 times a month. These infrequent vapers would have a low health risk, according to Benowitz, who is a professor of medicine emeritus in the Division of Cardiology and Center for Tobacco Control Research and Education at the University of California San Francisco.

“The strongest evidence for human disease risk relies on epidemiology studies, which unfortunately for most of the potential harmful effects of vaping will take many years,” Benowitz wrote in his commentary.

The Policy Recommendations

After outlining the limited data on cardiovascular effects of vaping in youth, the statement’s authors recommended specific actions for policy makers:

• Adopt measures to reduce youth access to e-cigarettes including removing all flavored e-cigarettes.
• Restrict marketing of e-cigarettes to youth in traditional and online media platforms to the extent allowable under the law.
• Offer hospital and health care facility-based cessation programs for adolescents and parents that are covered by health insurance.
• Develop medical school curricula on vaping’s long-term and short-term risks.
• Incorporate e-cigarettes as part of smoke-free indoor air laws.

The Clinical Takeaway

Benowitz summed up the findings in his commentary: “As reviewed by the writing group, the strongest epidemiological evidence for vaping harm to adolescents is an increased incidence of wheezing and cough, which may be related to irritant effects of aerosol chemicals.”

Wold said clinicians can help educate parents and children on the dangers of vaping, as well as advocate for stricter laws to ban sales and marketing of e-cigarettes to adolescents.

Limiting nicotine sales, including sales of e-cigarettes, to specialty tobacco shops could help enforce age restrictions, according to Benowitz. It’s also reasonable to talk with adolescents about the additional risks of vaping including nicotine addiction, emotional distress, and cost, he added. In his view, clinicians should support efforts to restrict youth access to vaping but at the same time create opportunities for adults to use the approach to quit traditional combustible cigarettes that carry greater, known health risks.

“All of us in the field are sort of looking towards what’s called the cigarette endgame or tobacco endgame,” Benowitz said. “The balance is really how do we optimize the chances of getting rid of smoking while minimizing the risks of adolescent vaping.”

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Conflict of Interest Disclosures: Dr Benowitz reported that he has been a consultant to Pfizer and Achieve Life Sciences, companies that market or are developing smoking cessation medications, and has been an expert witness in litigation against tobacco companies in relation to cigarette smoking. Dr Wold reported that he receives funding from the American Heart Association and the National Institutes of Health for research on vaping and serves as the editor in chief of Life Sciences, an Elsevier journal.

Note: Source references are available through embedded hyperlinks in the article text online.