



## The Impact of E-Cigarettes on the Lung

E-cigarettes are a relatively new tobacco product that have been sold in the U.S. for about a decade. The e-cigarettes currently in the U.S. marketplace have not been systemically reviewed by the Food and Drug Administration to determine their impact on lung health. While much remains to be determined about the lasting health consequences of these products, the American Lung Association is very troubled by the evolving evidence about the impact of e-cigarettes on the lungs.

### The Inhalation of Harmful Chemicals Can Cause Irreversible Lung Damage and Lung Disease

In January 2018, the National Academies of Science, Engineering and Medicine<sup>1</sup> released a consensus study report that reviewed over 800 different studies.

*That report made clear: using e-cigarettes causes health risks. It concluded that e-cigarettes both contain and emit a number of potentially toxic substances. The Academies' report also states there is moderate evidence that youth who use e-cigarettes are at increased risk for cough and wheezing and an increase in asthma exacerbations.*



A study from the University of North Carolina found that the two primary ingredients found in e-cigarettes – propylene glycol and vegetable glycerin – are toxic to cells, and that the more ingredients in an e-liquid, the greater the toxicity.<sup>2</sup>



E-cigarettes produce a number of dangerous chemicals including acetaldehyde, acrolein, and formaldehyde. These aldehydes can cause lung disease, as well as cardiovascular (heart) disease.<sup>3</sup>



E-cigarettes also contain acrolein, a herbicide primarily used to kill weeds. It can cause acute lung injury and COPD and may cause asthma and lung cancer.<sup>4</sup>



Both the U.S. Surgeon General and the National Academies of Science, Engineering and Medicine have warned about the risks of inhaling secondhand e-cigarette emissions, which are created when an e-cigarette user exhales the chemical cocktail created by e-cigarettes.



In 2016, the Surgeon General concluded that secondhand emissions contain, “nicotine; ultrafine particles; flavorings such as diacetyl, a chemical linked to serious lung disease; volatile organic compounds such as benzene, which is found in car exhaust; and heavy metals, such as nickel, tin, and lead.”



The Food and Drug Administration has not found any e-cigarette to be safe and effective in helping smokers quit. If smokers are ready to quit smoking for good, they should call 1-800-QUIT NOW or talk with their doctor about finding the best way to quit using proven methods and FDA-approved treatments and counseling.

<sup>1</sup> NAM Report - <https://www.nap.edu/resource/24952/012318ecigaretteConclusionsbyEvidence.pdf>

<sup>2</sup> Sassano MF, Davis ES, Keating JE, Zorn BT, Kochar TK, Wolfgang MC, et al. (2018) Evaluation of e-liquid toxicity using an open-source high-throughput screening assay. PLoS Biol 16(3): e2003904. <https://doi.org/10.1371/journal.pbio.2003904>

<sup>3</sup> Ogunwale, Mumiye A et al. (2017) Aldehyde Detection in Electronic Cigarette Aerosols. ACS omega 2(3): 1207-1214. doi: 10.1021/acsomega.6b00489.

<sup>4</sup> Bein K, Leikauf GD. (2011) Acrolein - a pulmonary hazard. Mol Nutr Food Res 55(9):1342-60. doi: 10.1002/mnfr.201100279.

## PATIENT EDUCATION | INFORMATION SERIES

# Vaping/Electronic Nicotine Delivery Systems

Vaping is a word used to describe the use of an electronic nicotine delivery system. It's called vaping because of the aerosol cloud given off during use.



Sample of e-cigarette products. Images are not to scale.  
Vaporizer products are considered "tank systems."

Used with permission from the Campaign for Tobacco-Free Kids at <https://www.tobaccofreekids.org/>

## What is an Electronic Nicotine Delivery System (ENDS)?

ENDS is a catch-all phrase for the different electronic devices used to vape. These devices may or may not look like a traditional cigarette. ENDS are battery-powered devices that heat a liquid into an aerosol that the user inhales. The liquid usually has nicotine, which comes from tobacco, flavorings, and other additives.

ENDS use have NOT been shown to be effective for stopping smoking. There are increasing concerns about the hazards to health of ENDS use, and of breathing in the emissions from ENDS devices.

ENDS appear to serve as a gateway drug. Their use increases risk for other tobacco product use (including traditional cigarettes) among young people.

ENDS devices are now the most popular tobacco products used by middle and high school students. ENDS products come in many different shapes and sizes and have many different names, often making it difficult for someone to understand what they are. Here is a list of the most common ones you will hear about:

### Electronic cigarette (e-cigarette; e-cig)

These devices look like cigarettes. Some are disposable. Some have rechargeable batteries and replaceable e-liquid cartridges.

### Other devices

There are many other types of electronic nicotine delivery systems in a wide variety of shapes and sizes.

Most of these products do not look like cigarettes. Some of the names for the different products include: Vape Pens, Vape Boxes, Vapes, Tank systems, E-Hookah, Hookah Pen, Hookah Stick, Shisha Stick, Juul, Mechanical Mods, E-Cigar, and E-Pipe.

### Concentrated Nicotine Solution

The concentrated nicotine solution used in some of these devices is called e-liquid or e-juice. Usually the solutions contain either the chemical compound propylene glycol or vegetable glycerin, nicotine, and flavorings. The ingredients often vary by brand and for each type of electronic product. At this time, there are very few rules or regulations that control how these products are made or advertised.

### Are they addictive?

Most of the ENDS products contain nicotine. Nicotine is one of the most addictive substances known. This is the same nicotine that is in tobacco products. Addiction to the nicotine means that you feel the need to keep putting nicotine into your body. Your body depends on it and you will have symptoms that make you uncomfortable—sometimes very uncomfortable—if you don't get enough of it or if you don't get it often enough.

Actual nicotine content in these products may vary from the labeled content. ENDS products labeled as not having nicotine may have nicotine.

Young people who become initiated to nicotine addiction with ENDS are more likely to go on to use of other tobacco products.



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**What about the flavors?**

There are hundreds of different flavors available. Fruit and candy flavors are especially popular with younger users. Although these flavors have been labeled as safe to eat there are major concern about what happens when you inhale them into your lungs. Many of the flavorings used are known to cause respiratory irritation. Others are toxic to lung tissue.

**SPECIAL CONCERN—**

E-liquids should be kept well out of reach of children. Nicotine poisoning can be fatal. As little as 1/2 teaspoon of the concentrated liquid nicotine can kill a young child.

**Are they safe?**

The simple answer is—No. Tobacco related toxins (poisonous substances that can cause disease) and carcinogens (cancer causing chemicals) have also been found in the aerosol vapor of ENDS products. Tiny heavy metal particles that are most likely from the casings and heating elements have been found in the aerosols created from device use. Heating of the ENDS solution can create other toxins and carcinogens. There is increasing evidence that inhaled nicotine from ENDS damages lung tissue and lowers the body's natural resistance to infections and to cancers. Although much is as yet unknown about their longterm safety, there is plenty of cause for concern.

**Are they useful in helping someone to quit smoking cigarettes?**

Some people claim they have quit smoking cigarettes by using an e-cig. However, results from recent research studies have not been able to show that they are effective in helping people stop smoking. Other research suggests that smokers who use ENDS are less likely to stop smoking. Young people who use ENDS are more likely to start smoking! Keep in mind that these products have few regulations or standards governing their manufacturing or contents. Products not regulated by the FDA (US Food and Drug Administration) do not hold to the same standards of quality, safety, and effectiveness as products that are regulated and approved for smoking cessation such as the nicotine patch, nicotine gum, and nicotine lozenge.

(For more information on products used to help quit smoking, see ATS patient handouts on Cessation, Over The Counter (OTC) and Prescription medicines.)

**Your use of ENDS can harm people close to you.**

Electronic nicotine delivery systems create aerosols. These aerosols (vapors) can and do expose others nearby. Protect your family and friends. If you do use these devices, only use them outside and well away from other people. Many states have put laws in place that prohibit the use of these devices in places where you cannot smoke. These devices cannot be used on commercial airplanes.

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**R<sub>x</sub> Action Steps**

- ✓ Avoid using ENDS.
- ✓ Do not allow ENDS device use in your home or car.
- ✓ Talk to your children about the dangers of ENDS use and of nicotine addiction.
- ✓ Children learn what they see. Set a good example by being ENDS and tobacco free.
- ✓ Keep all ENDS devices, including concentrated nicotine solutions, out of reach of children.
- ✓ If you are trying to stop smoking, talk with your health care provider about safe and effective medications to treat nicotine addiction and to help you to feel comfortable when not smoking or using tobacco.
- ✓ For help with stopping tobacco use go to [www.thoracic.org/patients/](http://www.thoracic.org/patients/).
- ✓ For additional help in quitting, join a local quit smoking support group or call 1-800-QUIT-NOW

**Resources**

**ATS Patient Information Series on Tobacco at**  
[www.thoracic.org/patients](http://www.thoracic.org/patients)

**FDA (Food and Drug Administration):**  
<http://www.fda.gov/newsevents/publichealthfocus/ucm172906.htm>

**American Legacy Foundation [www.legacyforhealth.org](http://www.legacyforhealth.org)**  
<http://truthinitiative.org/topics/tobacco-products/e-cigarettes>

**American Academy of Pediatrics – Healthy Children**  
<https://www.healthychildren.org/English/safety-prevention/at-home/Pages/Liquid-Nicotine-Used-in-E-Cigarettes-Can-Kill-Children.aspx>

**National Cancer Institute**  
[Smokefree.gov](http://Smokefree.gov)

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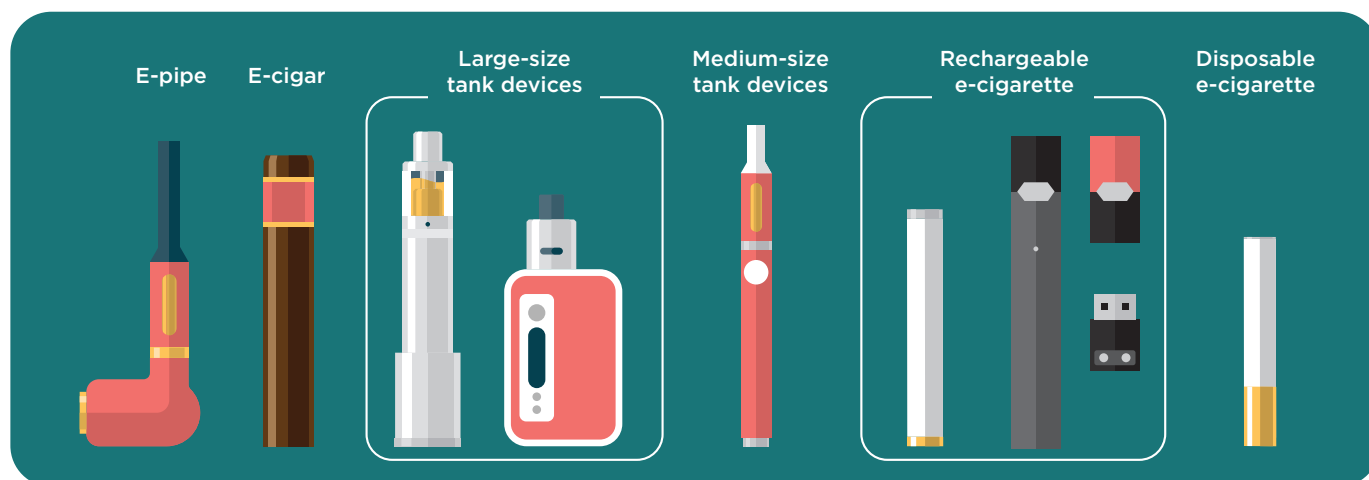
[www.thoracic.org](http://www.thoracic.org)

# ELECTRONIC CIGARETTES WHAT'S THE BOTTOM LINE?

- » E-cigarettes have the potential to benefit adult smokers who are not pregnant if used as a complete substitute for regular cigarettes and other smoked tobacco products.
- » E-cigarettes are not safe for youth, young adults, pregnant women, or adults who do not currently use tobacco products.
- » While e-cigarettes have the potential to benefit some people and harm others, scientists still have a lot to learn about whether e-cigarettes are effective for quitting smoking.
- » If you've never smoked or used other tobacco products or e-cigarettes, don't start.

## WHAT ARE E-CIGARETTES?

- » E-cigarettes are known by many different names. They are sometimes called “e-cigs,” “e-hookahs,” “mods,” “vape pens,” “vapes,” “tank systems,” and “electronic nicotine delivery systems.”
- » Some e-cigarettes are made to look like regular cigarettes, cigars, or pipes. Some resemble pens, USB sticks, and other everyday items.
- » E-cigarettes produce an aerosol by heating a liquid that usually contains nicotine—the addictive drug in regular cigarettes, cigars, and other tobacco products—flavorings, and other chemicals that help to make the aerosol. Users inhale this aerosol into their lungs. Bystanders can also breathe in this aerosol when the user exhales into the air.
- » E-cigarettes can be used to deliver marijuana and other drugs.



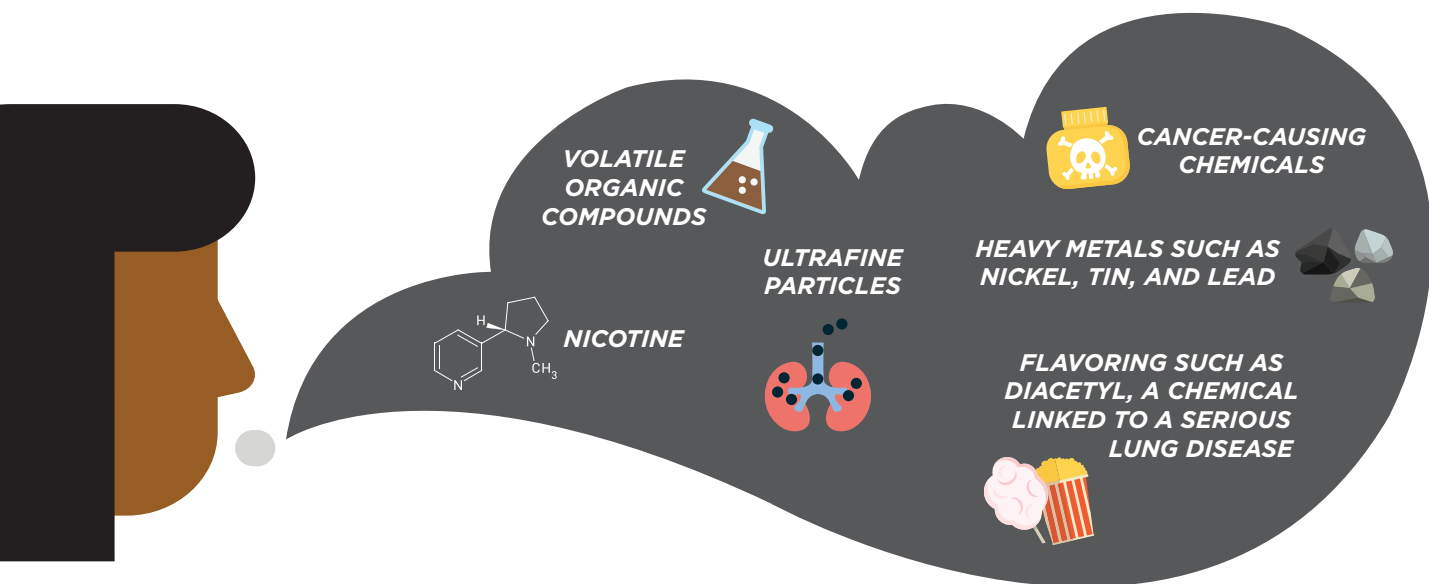
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U.S. Department of  
Health and Human Services  
Centers for Disease  
Control and Prevention

## WHAT IS IN E-CIGARETTE AEROSOL?

THE E-CIGARETTE AEROSOL THAT USERS BREATHE FROM THE DEVICE AND EXHALE CAN CONTAIN HARMFUL AND POTENTIALLY HARMFUL SUBSTANCES:



It is difficult for consumers to know what e-cigarette products contain. For example, some e-cigarettes marketed as containing zero percent nicotine have been found to contain nicotine.

## ARE E-CIGARETTES LESS HARMFUL THAN REGULAR CIGARETTES?



**VS**



**YES**, but that doesn't mean e-cigarettes are safe.

E-cigarette aerosol generally contains fewer toxic chemicals than the deadly mix of 7,000 chemicals in smoke from regular cigarettes. However, e-cigarette aerosol is not harmless. It can contain harmful and potentially harmful substances, including nicotine, heavy metals like lead, volatile organic compounds, and cancer-causing agents.

# WHAT ARE THE HEALTH EFFECTS OF USING E-CIGARETTES?

SCIENTISTS ARE STILL LEARNING ABOUT THE LONG-TERM HEALTH EFFECTS OF E-CIGARETTES. HERE IS WHAT WE KNOW NOW.

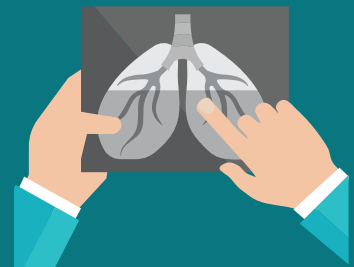
## 1 Most e-cigarettes contain nicotine, which has known health effects

- » Nicotine is highly addictive.
- » Nicotine is toxic to developing fetuses.
- » Nicotine can harm adolescent brain development, which continues into the early to mid-20s.
- » Nicotine is a health danger for pregnant women and their developing babies.



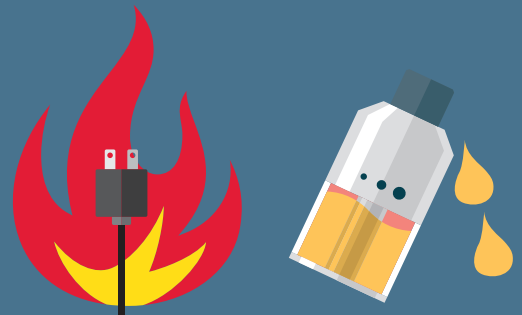
## 2 Besides nicotine, e-cigarette aerosol can contain substances that harm the body.

- » This includes cancer-causing chemicals and tiny particles that reach deep into lungs. However, e-cigarette aerosol generally contains fewer harmful chemicals than smoke from burned tobacco products.

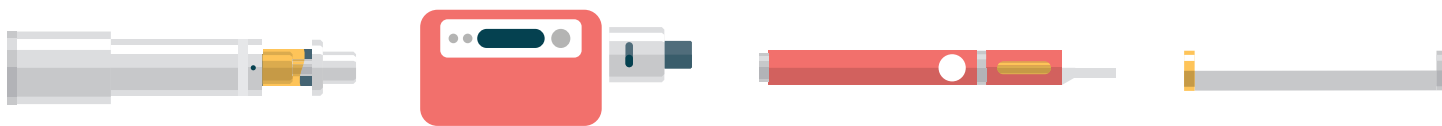


## 3 E-cigarettes can cause unintended injuries.

- » Defective e-cigarette batteries have caused fires and explosions, some of which have resulted in serious injuries.
- » In addition, acute nicotine exposure can be toxic. Children and adults have been poisoned by swallowing, breathing, or absorbing e-cigarette liquid.



## CAN E-CIGARETTES HELP ADULTS QUIT SMOKING CIGARETTES?



### E-CIGARETTES ARE NOT CURRENTLY APPROVED BY THE FDA AS A QUIT SMOKING AID.

The U.S. Preventive Services Task Force, a group of health experts that makes recommendations about preventive health care, concluded that the evidence is insufficient to recommend e-cigarettes for smoking cessation in adults, including pregnant women.



**HOWEVER,** e-cigarettes may help non-pregnant adult smokers if used as a complete substitute for all cigarettes and other smoked tobacco products.

### TO DATE, THE FEW STUDIES ON THE ISSUE ARE MIXED.

Evidence from two randomized controlled trials found that e-cigarettes with nicotine can help smokers stop smoking in the long term compared with placebo (non-nicotine) e-cigarettes.

A recent CDC study found that many adults are using e-cigarettes in an attempt to quit smoking. However, most adult e-cigarette users do not stop smoking cigarettes and are instead continuing to use both products (“dual use”). Because smoking even a few cigarettes a day can be dangerous, quitting smoking completely is very important to protect your health.



## WHO IS USING E-CIGARETTES?

E-CIGARETTES ARE THE MOST COMMONLY USED TOBACCO PRODUCT AMONG YOUTH.

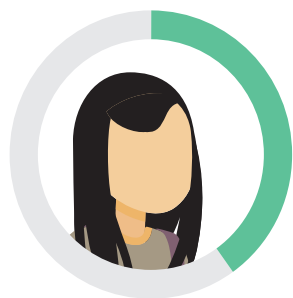
IN THE U.S.,  
YOUTH ARE  
MORE LIKELY  
THAN ADULTS  
TO USE  
E-CIGARETTE



**4.9%**  
MIDDLE SCHOOL  
STUDENTS

In 2018, more than  
**3.6 MILLION**  
U.S. middle and high school  
students used e-cigarettes in  
the past 30 days, including:

**20.8%**  
HIGH SCHOOL  
STUDENTS



**AMONG CURRENT E-CIGARETTE USERS AGED 45 YEARS AND OLDER**  
in 2015, most were either current or former regular cigarette smokers, and 1.3% had never been cigarette smokers.

**IN CONTRAST, AMONG CURRENT E-CIGARETTE USERS AGED 18–24 YEARS,**  
**40.0%** had **NEVER BEEN** regular cigarette smokers

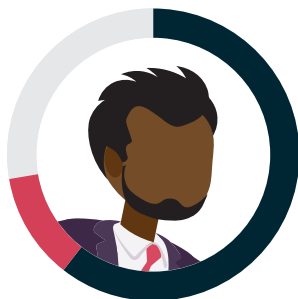
IN 2015, AMONG ADULT E-CIGARETTE  
USERS OVERALL:

**29.8%**

were former  
regular cigarette  
smokers

**11.4%**

had never been  
regular cigarette  
smokers



**58.8%**

were current regular  
cigarette smokers

ADULTS

In 2017, **2.8%**  
of U.S. adults were current  
e-cigarette users

