



## The science about vaping dangers – and what we don't know yet

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In a very short period of time, vaping has moved from a concerning trend to an epidemic, threatening the health of our nation's youth with nicotine and other chemicals.

Over 5 million teens use e-cigarettes – more than double the number two years ago. At least one out of every four high-school students is vaping. And kids across the country are becoming addicted to nicotine, just as our decades of work helped bring cigarette smoking to a new low.

Even though there is more work needed to fully understand all the dangers of e-cigarettes, there's plenty of evidence they're harmful for growing minds and bodies.

The American Heart Association is working to combat this problem the same way we have battled health problems for nearly a century: We're relying on the science.

Our organization tackles public health concerns through research, education, advocating for new laws and policies, and awareness campaigns. No matter how we're working to help people live longer, healthier lives, everything starts with science.

That's why we are funding \$20 million of new research to understand how vaping and nicotine affect the still growing hearts, brains, lungs and blood vessels of young people. This is important because there are few studies in this area.

Here's a look at the latest science about vaping and nicotine, as well what science hasn't uncovered yet.

### **Safety of vaping vs. cigarettes**

One of the most basic things people want to know is whether vaping is better for you than cigarettes. It's easy to jump to the conclusion that vaping is better. After all, there is no mystery about smoking: It can kill you.

The problem is, no one knows if vaping is safe in the long run because e-cigarettes haven't been around long enough to be studied deeply. Some diseases can take years and even decades to develop, including cancer and atherosclerosis (artery blockages that can cause heart attacks and strokes).

Another reason it's difficult to study vaping is that people switch back and forth between smoking, vaping and not using either. We can see short-term effects in animals exposed to one or another, but understanding long-term effects requires long-term studies.

In addition to a lack of sufficient research, some contents of e-cigarettes remain unknown. The Food and Drug Administration – responsible for judging the safety of things Americans put into their bodies – has not yet evaluated these products for safety.

We do know that the lines between the vaping industry and Big Tobacco have blurred. Altria, the maker of Marlboro and Skoal, has invested more than \$12 billion into Juul, which makes e-cigarettes that are extremely popular with young people. The investment represents a 35% ownership stake in JUUL.

Big Tobacco has a history of misrepresenting facts about nicotine and smoking. So vaping-safety claims from industry or research supported by industry should be met with skepticism. For example, there's the claim that vaping produces only water "vapor" or aerosols – which sound far healthier than cigarette smoke. But there is a lot more than water in that aerosol.

The aerosols actually contain multiple chemicals known to be toxic. Some aerosols contain heavy metals and other toxic ingredients (like the volatile organic compounds you try to avoid in some house paint).

Some of the flavors designed to make e-cigarettes more attractive to children have been shown to harm lung tissue, heart muscle cells, the lining cells of blood vessels, and the cells we need for blood clotting after injury.

These studies have been done in cells from human volunteers, and in some cases, the functions of these cells have been studied in volunteers after they vape.

Even the chemicals used to deliver the aerosol (like propylene glycol or glycerol) can be toxic, as can the heavy metals often produced by these delivery systems themselves. And remember, aerosols are inhaled deep into the lungs, where their effects may be long-lasting.

Further, we don't know if "secondhand vaping" can be harmful in the long term. We need more research, considering people frequently vape in public. In fact, nicotine has been detected in areas where people have vaped.

### **E-cigarettes as tools to quit smoking**

The idea that vaping is a better way to quit cigarettes than reliable methods using FDA-approved nicotine replacement products isn't backed up by the weight of science.

Of the small number of studies about this, most show no advantage for e-cigarettes over the temporary use of FDA-approved products such as gum, lozenges and patches. The latter products have been proven helpful as part of an overall program for quitting, which should also include counselling and can include medications to reduce cravings.

One study frequently cited by industry and its supporters did show e-cigarettes to be effective in stopping smoking. However, as is often the case with science, that part of the study's results doesn't tell the whole story.

The study, published in *The New England Journal of Medicine*, was conducted in England. That's significant because the e-cigarettes in England are far different from those in the U.S. English products have much lower levels of nicotine, and physicians there actually encourage their use to quit smoking.

Two reports from Public Health England are often referenced for stating "e-cigarettes are less harmful than combustible cigarettes." But those studies did not compare e-cigarette use to zero-nicotine exposure. And, those reports rely on small studies or reviews sponsored by organizations supported by Big Tobacco.

Some U.S. smokers have used e-cigarettes to quit, but a growing body of studies shows that approach doesn't work for many people. They cut back, but they still smoke while vaping and they remain addicted. That's called "dual use" in public health literature. The dangers of cigarettes remain, with the added dangers of vaping.

Unfortunately, dual use is a major problem among young people. Dual use also is something we are working to address through our massive new initiative combatting youth vaping called #QuitLying. Research shows some kids who had never smoked but began their exposure to nicotine by vaping later switched to smoking or did both.

The AHA advises anyone quitting smoking to get off nicotine products altogether, using FDA-approved tools proven to be effective. We also don't want anyone to ever start any nicotine-containing product.

### **The dangers of nicotine and the unknown**

When discussing the dangers of e-cigarettes, many people think about the [tragic outbreak of vaping-related deaths](#) across the country. As an organization we are extremely concerned about this problem, which is still being investigated and has been linked to vaping THC as well as using "off-brand" e-cigarette products.

But nicotine remains a major concern about e-cigarettes. They can contain unusually high levels of nicotine. One e-cigarette refill pod can contain as much nicotine as an entire pack of cigarettes. And kids are sometimes vaping 2-4 pods a day.

That's especially troubling because many studies in animals show nicotine is a neurotoxin (a poison affecting the nervous system). It can affect brain development from early fetal life through adolescence, permanently changing the ability to think or reason.

The National Academies of Science, Engineering and Medicine and the World Health Organization believe nicotine delivery via e-cigarettes during pregnancy can adversely affect the development of the fetus, and can affect immune system and lung function.

An AHA review of published science found data that raised serious concerns about the impact vaping nicotine is likely having on teens.

Among the findings comparing teens exposed to nicotine to those who are not: severe consequences related to cognitive ability, emotional problems and addiction. Based on what we know about nicotine exposure, especially at the high levels, vaping as a teen can be highly addictive and lead to lifelong use.

Kids tell us that they are becoming addicted, and that they are finding it very difficult, and in some cases, impossible to quit. This is an acute problem we need to solve as soon as possible – especially since young people’s brains aren’t fully developed until they’re in their 20s.

We’ll start learning more with our new research initiative. It will explore:

- Nicotine’s impact on adolescent brain development, intelligence and learning
- The role and influence of device type, flavors and other e-cigarette chemicals and byproducts on addiction
- Discovering or defining effective approaches to reverse nicotine addiction in youth using novel approaches proven to be effective.

### **Why we care**

As the nation’s oldest and largest nonprofit organization fighting heart disease and stroke – the leading causes of death in the world – the health of the country is our business. And we conduct our business based on scientific evidence.

We’ve worked against Big Tobacco for decades, and we know the way to fight misinformation is with legitimate scientific findings.

The science to date is clear: Vaping and nicotine are not safe – especially for youth and their growing brains and bodies.