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Electronic Cigarettes (E-cigarettes)

What are electronic cigarettes?

Electronic cigarettes, also known as e-cigarettes, e-vaporizers, or electronic nicotine delivery systems, are battery-operated devices that people use to inhale an aerosol, which typically contains nicotine (though not always), flavorings, and other chemicals. They can resemble traditional tobacco cigarettes (*cig-a-likes)*, cigars, or pipes, or even everyday items like pens or USB memory sticks. Other devices, such as those with fillable tanks, may look different. Regardless of their design and appearance, these devices generally operate in a similar manner and are made of similar components. More than 460 different e-cigarette brands are currently on the market.[1] Some common nicknames for e-cigarettes are:

- e-cigs
- e-hookahs
- hookah pens
- vapes
- vape pens
- mods (customizable, more powerful vaporizers)

Photo by Mandie Mills, CDC

How do e-cigarettes work?

Most e-cigarettes consist of four different components, including:

- a cartridge or reservoir, which holds a liquid solution (*e-liquid* or *e-juice*) containing varying amounts of nicotine, flavorings, and other chemicals
- a heating element (atomizer)
- a power source (usually a battery)
- a mouthpiece that the person uses to inhale

In many e-cigarettes, puffing activates the battery-powered heating device, which vaporizes the liquid in the cartridge. The person then inhales the resulting aerosol or vapor (called *vaping*).

E-cigarette Use in Teens

E-cigarettes are popular among teens and are now the most commonly used form of tobacco among youth in the United States. Their easy availability, alluring advertisements, various e-liquid flavors, and the belief that they're safer than cigarettes have helped make them appealing to this age group. Further, a study of high school students found that one in four teens reported using e-cigarettes for *dripping*, a practice in which people produce and inhale vapors by placing e-liquid drops directly onto heated atomizer coils. Teens reported the following reasons for dripping: to create thicker vapor (63.5 percent), to improve flavors (38.7 percent), and to produce a stronger throat hit—a pleasurable feeling that the vapor creates when it causes the throat to contract (27.7 percent).[2] More research is needed on the risks of this practice.

In addition to the unknown health effects, early evidence suggests that e-cigarette use may serve as an introductory product for preteens and teens who then go on to use other tobacco products, including cigarettes, which are known to cause disease and premature death. A study showed that students who had used e-cigarettes by the time they started 9th grade were more likely than others to start smoking cigarettes and other smokable tobacco products within the next year.[3] Another study supports these findings, showing that high school students who used e-cigarettes in the last month were about 7 times more likely to report that they smoked cigarettes when asked approximately 6 months later, as compared to students who said they didn't use e-cigarettes. Notably, the reverse was not true—students who said they smoked cigarettes were no more likely to report use of e-cigarettes when asked approximately 6 months later. Like the previous study, these results suggest that teens using e-cigarettes are at a greater risk for smoking cigarettes in the future.[4] Another study has shown an association between e-cigarette smoking and progression to smoking actual cigarettes.[5] This study suggests that e-cigarettes may actually encourage cigarette smoking in adolescents.

Additionally, a study of adult smokers in Europe found those who used e-cigarettes were less like to have stopped smoking than those that didn't use e-cigarettes. Those that used e-cigarettes also smoked more cigarettes than those who didn't.[6] In another study of more than 800 people who said they were using e-cigarettes to help them quit traditional cigarette smoking, only nine percent reported having quit when asked a year later.[7] However, more research is still needed to understand if experimenting with e-cigarettes leads to regular use of smokable tobacco.

Under U.S. Food and Drug Administration (FDA) regulations designed to protect the health of young Americans, minors can no longer buy e-cigarettes in stores or online (see "Government Regulation of E-cigarettes"). The FDA now regulates the manufacture, import, packaging, labeling, advertising, promotion, sale, and distribution of e-cigarettes. This includes components and parts of e-cigarettes but excludes accessories.[8]

How do e-cigarettes affect the brain?

Government Regulation of E-cigarettes

In 2016, the FDA established a rule for e-cigarettes and their liquid solutions. Because e-cigarettes contain nicotine derived from tobacco, they are now subject to government regulation as tobacco products, including the requirement that both in-store and online purchasers be at least 18 years of age (see "E-cigarette Use in Teens"). For more information about this ruling, visit the FDA's webpage, The Facts on the FDA's New Tobacco Rule.

The nicotine in e-liquids is readily absorbed from the lungs into the bloodstream when a person uses an e-cigarette. Upon entering the blood, nicotine stimulates the adrenal glands to release the hormone epinephrine (adrenaline). Epinephrine stimulates the central nervous system and increases blood pressure, breathing, and heart rate. As with most addictive substances, nicotine activates the brain's reward circuits and also increases levels of a chemical messenger in the brain called *dopamine*, which reinforces rewarding behaviors. Pleasure caused by nicotine's interaction with the reward circuit motivates some people to use nicotine again and again, despite risks to their health and well-being.

What are the health effects of e-cigarettes? Are they safer than tobacco cigarettes?

Research so far suggests that e-cigarettes might be less harmful than cigarettes when people who regularly smoke switch to them as a complete replacement. But nicotine in any form is a highly addictive drug. Research suggests it can even prime the brain's reward system, putting vapers at risk for addiction to other drugs.[9]

Also, e-cigarette use exposes the lungs to a variety of chemicals, including those added to e-liquids, and other chemicals produced during the heating/vaporizing process.[10] A study of some e-cigarette products found the vapor contains known carcinogens and toxic chemicals, as well as potentially toxic metal nanoparticles from the device itself. The study showed that the e-liquids of certain cig-a-like brands contain high levels of nickel and chromium, which may come from the nichrome heating coils of the vaporizing device. Cig-a-likes may also contain low levels of cadmium, a toxic metal also found in cigarette smoke that can cause breathing problems and disease.[11] More research is needed on the health consequences of repeated exposure to these chemicals.

Reports of Deaths Related to Vaping

The Food and Drug Administration has alerted the public to hundreds of reports of serious lung illnesses associated with vaping, including several deaths. They are working with the Centers for Disease Control and Prevention (CDC) to investigate the cause of these illnesses. Many of the suspect products tested by the states or federal health officials have been identified as vaping products containing THC, the main psychotropic ingredient in marijuana. Some of the patients reported a mixture of THC and nicotine; and some reported vaping nicotine alone. No one substance has been identified in all of the samples tested, and it is unclear if the illnesses are related to one single compound. Until more details are known, FDA officials have warned people not to use any vaping products bought on the street, and they warn against modifying any products purchased in stores. They are also asking people and health professionals to report any adverse effects. The CDC has posted an information page for consumers.

Health Effects for Teens

The teen years are critical for brain development, which continues into young adulthood. Young people who use nicotine products in any form, including e-cigarettes, are uniquely at risk for long-lasting effects. Because nicotine affects the development of the brain's reward system, continued e-cigarette use can not only lead to nicotine addiction, but it also can make other drugs such as cocaine and methamphetamine more pleasurable to a teen's developing brain.[12]

Nicotine also affects the development of brain circuits that control attention and learning. Other risks include mood disorders and permanent problems with impulse control—failure to fight an urge or impulse that may harm oneself or others.[12]

Can e-cigarettes help a person quit smoking?

Some people believe e-cigarettes may help lower nicotine cravings in those who are trying to quit smoking. However, e-cigarettes are not an FDA-approved quit aid, and there is no conclusive scientific evidence on the effectiveness of e-cigarettes for long-term smoking cessation. It should be noted that there are seven FDA-approved quit aids that are proven safe and can be effective when used as directed.

E-cigarettes haven't been thoroughly evaluated in scientific studies. For now, not enough data exists on the safety of e-cigarettes, how the health effects compare to traditional cigarettes, and if they are helpful for people trying to quit smoking.

Points to Remember

- Electronic cigarettes are battery-operated devices that people use to inhale an aerosol, which typically contains nicotine (though not always), flavorings, and other chemicals. In many e-cigarettes, puffing activates the battery-powered heating device, which vaporizes the liquid in the cartridge or reservoir. The person then inhales the resulting aerosol or vapor (called *vaping*).
- E-cigarettes are popular among teens. Under U.S. Food and Drug Administration (FDA) regulations designed to protect the health of young Americans, minors can no longer buy e-cigarettes in stores or online.
- Nicotine stimulates the adrenal glands to release the hormone epinephrine (adrenaline) and increases the levels of a chemical messenger in the brain called *dopamine*. Pleasure caused by nicotine's interaction with the brain's reward system motivates some people to use nicotine again and again, despite possible risks to their health and well-being.
- Research so far suggests that e-cigarettes are less harmful than cigarettes when people who regularly smoke switch to them as a complete replacement. But e-cigarettes can still damage a person's health.
- E-cigarettes can lead to nicotine addiction and increased risk for addiction to other drugs.
- E-cigarette use also exposes the lungs to a variety of chemicals, including those added to e-liquids, and other chemicals produced during the heating/vaporizing process.
- More research is needed to determine if e-cigarettes may be as effective as smoking cessation aids already approved by the FDA.

Learn More

For more information about e-cigarettes, visit:

- the NIDA TV Spotlight on Electronic Cigarettes
- A NIDA Science Spotlight on the association between e-cigarette use and future tobacco cigarette use
- the FDA's webpage, Vaporizers, E-Cigarettes, and other Electronic Nicotine Delivery Systems (ENDS)
- the website, Know the Risks: E-cigarettes & Young People, based on the U.S. Surgeon General's Report on e-cigarette use among youth and young adults; includes various resources such as a parent tip sheet, healthcare provider conversation card, and FAQs

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