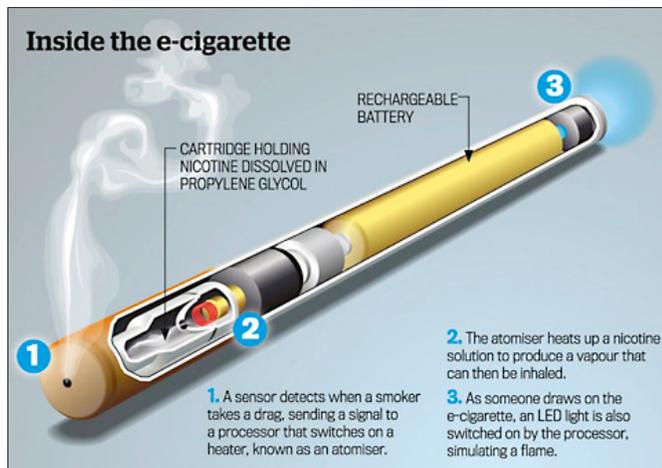




## E-cigarettes and Health

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### E-cigarettes: What are they?

Electronic cigarettes, also known as e-cigarettes, are devices that create an inhalable nicotine vapor by heating a liquid nicotine solution. While there are many different e-cigarette devices on the market, the basic operation and parts of a typical device are shown in the illustration above. The main components include a battery, a cartridge with nicotine and any flavoring, and a heater that vaporizes the nicotine to be inhaled by the user.

When the user puffs on the end of the device and creates a vacuum, a battery powers the heater and creates vapor, which then goes into a chamber. The vapor is drawn out of the end of the device and inhaled into the lungs.

Most e-cigarette devices are engineered to look like a cigarette, and they are used like a cigarette. Many even have a tip that lights up when a person is inhaling. Using an e-cigarette is called vaping. A number of very similar products on the market are sold as “e-Hookah,” or vaporizer pens. These products may or may not contain nicotine, and users do not generally consider them to be an e-cigarette. Young people may use vaporizer pens in social situations for “smoke tricks”; and vaporizer pens are also being used to heat and vaporize marijuana, herbs, waxes, or oils. These devices have the same mechanisms and risks as e-cigarettes, so the descriptions below apply to these products as well.

### How does e-cigarette vapor differ from cigarette smoke and why is this important?

E-cigarette vapor is white, like smoke, but does not contain the tar—the tiny particles from thousands of chemicals present when tobacco is burned. Instead, e-cigarette liquid contains nicotine, the vapor component (propylene glycol, glycerin or polyethylene glycol), and any added flavorings. Some e-cigarette cartridges do not contain any nicotine, but only the flavors and vapor.

The Food and Drug Administration (FDA) has classified propylene glycol and glycerin as “generally recognized as safe,” which means that they are acceptable for use in flavorings, drugs, and cosmetics, and as a direct food additive. However, there are hundreds of e-cigarette brands, and independent research has identified substantial differences in the concentration of nicotine in e-cigarette solutions from product-to-product and even within brands. Other chemicals have been found in e-cigarette solutions as well, including nicotine-related impurities and other drugs. The e-Hookah and vaporizer pen solutions include a broad range of reported contents, and many consumers make their own solutions.

### Nicotine addiction

Nicotine use leads to craving and addiction in the brain within a short period of exposure. When someone is addicted to nicotine, they have symptoms of craving and withdrawal when they don’t smoke for a while, such as when they first get up in the morning. These withdrawal symptoms are the brain’s way of telling the person they need a dose of nicotine. The withdrawal makes them feel anxious and stressed. Because smoking delivers nicotine to the brain quickly, withdrawal symptoms are relieved immediately when someone smokes.

Nicotine is as addictive as heroin, and nicotine causes addiction to smoking. Nicotine use is not without health consequences—it harms the fetus if pregnant women use it, it makes the heart work harder, and it may speed up the growth of cancers. Nicotine is also a poison, and there is legitimate concern that the nicotine in e-cigarette cartridges could harm or even kill a small child if it were ingested.

### Tar and carbon monoxide in cigarette smoke cause most of the health consequences of smoking

Still, nicotine causes few of the health consequences associated with smoking. Instead, the harms of tobacco use come from the other ingredients in tobacco including the tar and carbon monoxide in smoked tobacco. Chemicals in the tar are known to cause several different kinds of cancer. Direct contact of the tar with lung tissue transforms normal cells into cancer cells; other cancers form when the chemicals are absorbed into the body. The tar also has chemicals that destroy lung tissue directly, which is why smokers can get chronic lung diseases such as emphysema and chronic obstructive pulmonary disease (COPD). The tar from tobacco has still other chemicals that can increase risk for heart attack by changing the way blood flows through the heart. Finally, tobacco smoke includes carbon monoxide that attaches to blood cells and makes it harder for oxygen to be delivered to tissue, which further increases risk of heart attack. Because e-cigarette vapor does not contain tar or carbon monoxide, e-cigarette users are exposed to many fewer inhaled chemicals than cigarette smokers. This major difference—nicotine, vapor, and flavorings in e-cigarettes versus the complex mix of chemicals from tobacco smoke—is the reason some believe that e-cigarette use might be less harmful than smoking tobacco.

## Why would someone use an e-cigarette?

The market for e-cigarettes is growing at a huge rate in the U.S. Many people are purchasing e-cigarettes out of curiosity, or to use when trying to quit smoking. The difficulty is that we do not have good evidence that people quit smoking completely by using e-cigarettes. Using e-cigarettes can also encourage “dual use,” both smoking cigarettes and using e-cigarettes. Many will use e-cigarettes where smoking tobacco is not allowed, and smoke tobacco at other times. Since stopping smoking completely is the only way to limit the health consequences of smoking, we need to know if e-cigarettes help people quit or if they help more people put off quitting.

There is a newly developing market for vaporizer pens for individuals who use them not for tobacco replacement but for trick smoking, or for vaporizing other substances such as herbs, marijuana, marijuana oils, and hashish waxes.

## Are all e-cigarettes the same?

No. E-cigarettes were invented by a pharmacist in China, and many of the first generation products continue to be produced there. There are now more than 400 e-cigarette devices in the U.S. market, including some manufactured in the U.S., and the newer products differ from the original.

Early e-cigarettes delivered nicotine mainly to the surface of the mouth and throat, which created a nicotine exposure more like smokeless tobacco. Some studies indicated that experienced users of these products were able to reach high levels of nicotine in their blood, while less experienced users got very little. With technological improvements, and as large tobacco corporations produce e-cigarettes, the nicotine delivery appears to be changing. Early results suggest that the newer designs may be more like a cigarette, getting nicotine deeper into the lung with quicker absorption into the blood stream. This makes them more addictive, but may also make them a better substitute for cigarettes. The newest vaporizer pens are technically similar to an e-cigarette, but the contents of the cartridges, or what is consumed in the refills, likely varies dramatically from that in a “traditional” e-cigarette.

## What we don't know

Because e-cigarettes, e-Hookah, and vaporizers are completely unregulated by any agency, their safety and effectiveness has not been tested. No one can say that they are safer than other tobacco products (such as non-combusted tobacco products). This is one major reason why public health officials are reluctant to tell people to use them.

Since the quality of each device may vary, and the nicotine dose that an individual user may receive varies with the brand, battery charge level, “e-juice,” and experience of the user, it is hard to know how well any particular device works or what the user is inhaling.

We have little information about the safety of vapors like propylene glycol when they are heated and directly inhaled, rather

than eaten or used on the skin. The safety of many of the inhaled flavorings in the e-cigarette liquid is also not known; heating these flavorings could create new chemicals and byproducts. We don't know how safe it is to breathe “second hand vapor.”

The bottom line is that we do not know a lot about the safety of these products. As was the case for cigarettes, it will likely take many years for the risks and harms to be understood. Since these products are attracting a great deal of attention now, short-term research should be available in the next several years but long-term health risks will not be known for many years.

## Unregulated marketing for e-cigarettes and public health

Beyond safety, the marketing for e-cigarettes is unregulated. Just as they did with cigarettes in the 1950s, big tobacco companies are promoting e-cigarettes on TV and getting endorsements from Hollywood personalities. TV advertising reaches large audiences, and celebrity endorsements further increase their appeal to adolescents and young adults.

Since vaping an e-cigarette looks like smoking, increased e-cigarette use means more public displays of “smoking,” and young children may perceive this as common and “OK to do.” There is concern that never-smoking youth could take up e-cigarettes and develop nicotine addiction, while they may not have ever tried cigarette smoking. This could reverse the trend in declining smoking rates, and recruit young smokers who would not otherwise have used cigarettes. If experimenting with e-cigarettes leads to smoking tobacco products, the risk of serious health consequences increases for a generation of youth who are not currently smoking.

The possibility that e-cigarette use could help maintain a smoking habit (e.g., cigarettes or cigars) is perhaps most significant from a public health standpoint. Because electronic cigarettes are actively promoted for use in places where conventional cigarettes are not allowed, there is concern that smokers will use e-cigarettes to help them through periods when they cannot smoke, helping them to avoid quitting. Cigarette smoking is still the largest preventable cause of death in the world because it causes so many common diseases. Cutting down from a pack a day to a half a pack a day helps a little, but not enough to make a large difference in the death rates.

## What are the implications for a cigarette smoker?

Smokers considering e-cigarettes to help them quit smoking face a difficult personal choice. No public health official is going to issue a statement endorsing e-cigarette use for stopping smoking anytime soon. Yet, in theory, the exclusive use of e-cigarettes could be safer than smoking.

These theoretical benefits will be awarded to someone who uses e-cigarettes to completely quit smoking all products that burn tobacco—cigarettes, cigars, cigarillos, and pipes. Anyone who uses e-cigarettes and continues to use those other products is unlikely to greatly lower their risk of heart attack, cancer, or chronic lung disease. There are other forms of medicinal nicotine replacement therapy (NRT) that have been used for 17 years to help smokers quit. We know that these products help people successfully quit tobacco. Until we know more about e-cigarettes, these medicinal NRT products, combined with help from quit counselors or friends and family who have quit can help you become a non-smoker without tackling the remaining questions of e-cigarette safety.

NH Comprehensive Cancer Collaboration in partnership with Norris Cotton Cancer Center at Dartmouth-Hitchcock

