Vaping Is Far From Harmless

By [Leah Shaffer](http://www.pbs.org/wgbh/nova/next/author/leah-shaffer/) on Tue, 21 Jun 2016

Vicki Beckmann exhales a thick, sweet-smelling mist into the air of Vapor Worx, an e-cigarette shop in St. Charles, Missouri.

“I like more of the fruity stuff,” she says of the e-cigarette flavorings that line the walls of the shop.

Beckmann, an employee of Vapor Worx, began using an e-cigarette to quit regular cigarettes four years ago. She convinced her father to do the same. Her dad was warned smoking would kill him, she says. “I told him, just try it, and I’ll buy it for you.”

Now, he’s been cigarette free for three years, she says. And Beckmann is slowly lowering the levels of nicotine in the “juice” that fills his e-cigarette device. “He doesn’t wake up in the morning coughing all the time anymore. He just generally feels better,” she says.

As e-cigarettes take off in popularity, Beckmann’s story is not unique. The devices, which contain no tobacco but instead use heat to vaporize a nicotine-laced liquid, can be seen as a less toxic alternative to traditional cigarettes.

E-cigarettes are now a $6 billion industry worldwide.

Just a few short years ago, e-cigarette shops like Vapor Worx didn’t even exist, and now they fill the strip malls of towns like St. Charles, with names like VaporWize, Vapology, or others playing on “vape,” the name given to the practice of inhaling the nicotine-laced fog.

Where you find smokers, you’ll find demand for e-cigarettes or “vaping” products, and Missouri is no exception, with 21% of adults smoking tobacco, one of the higher rates in the country. E-cigarettes first emerged online in the mid-2000s, and the business has since grown to become $6 billion industry worldwide, eclipsing the total sales for all nicotine replacement therapy products. Today, it’s estimated that the industry is growing at an estimated rate of 42% per year, in part due to spending by big tobacco companies as they buff up their versions of e-cigs.

There are now hundreds of different devices and thousands of different flavors for those devices. But the hazy, lazy days at the vape shop may be numbered. This may, the FDA ruled that e-cigarettes products will be subject to the same regulation applied to cigarettes. In addition to prohibiting the sale of e-cigarettes to those under 18, this means that manufacturers and retailers of vapor “juices” will have to register ingredients with the FDA, a process that could be onerous and expensive for small operators. After August 8, vapor retailers will have three years to comply with the rules by registering and labeling their product ingredients.

For now, Vapor Worx owner Cliff Brown is waiting to see how it all plays out. “We have no idea of whose really going to be policing it,” he says.

**More Than One**

The reason for the confusion among health researchers and retailers is that an e-cigarette is not just one single device or chemical, making it hard to track and regulate. E-cigarettes can work in a couple of different ways. The most common are pen-shaped rechargeable devices that have a refillable tank that holds a nicotine-laced liquid flavor compound. The liquid is then vaporized but not burned by a heating element to produce an aerosol that delivers nicotine to the user.

Many people assume that e-cigarettes are less toxic than standard cigarettes, but there is little data to back that up.

But if someone is trying to switch to e-cigarettes from cigarettes, are they ultimately doing themselves a favor? “The short answer, is no,” says Dr. Stanton Glantz, a professor of medicine at the University of California, San Francisco.

Glantz analyzed a number of different studies that examined the use of e-cigarettes in quitting smoking. He found that use of e-cigarettes in fact lowered a person’s chance of successfully quitting cigarettes by 28%. This aligns with another recent study that found the most successful way to quit smoking is to go cold turkey instead of slowly weaning off cigarettes.

“The evidence is quite consistent that, for most people, they make it harder to quit,” Glantz says. “That doesn’t mean that some people don’t use some to quit. They do, but that’s a small fraction.”

Not everyone has come to the same conclusion, though. Muhannad Malas, a researcher at the University of Toronto, says that the lack of long-term randomized placebo-controlled studies has been problematic. In lieu of those, reviews of observational studies, like Glantz’s, are the next best thing. Malas’s own review of more 60 studies comparing e-cigs with smoking cessation aids found that they may be helpful for some smokers in quitting or reducing their cigarette smoking but, “the evidence was definitely inconclusive.”

**More Than Just “Harmless” Vapor**

The more scientists learn about e-cigarettes and their impact on human health, the more complicated the picture becomes. For one, no one knows exactly how toxic these products are because the use varies from person to person. And, contrary to what marketing materials may say, e-cigarettes produce a lot more than just “harmless” water vapor.

E-cigarette juice contains a mix of propylene glycol, glycerin, nicotine, and flavoring agents approved by the FDA as “Generally Recognized As Safe” (GRAS) for consumption. When this mix is heated, a group of compounds known as carbonyls are produced. This includes compounds such formaldehyde and acrolein. While cigarettes generally produce a thousand times more carbonyls because of the combustion process, e-cigarettes produce a varying amount depending on the ratio of glycol to glycerin in the vaping fluid and how much of it is heated, says Daniel Conklin, an environmental cardiologist at the University of Louisville.

Conklin has investigated how e-cigarettes might affect cardiovascular disease using a type of mouse bred with a disorder that mimics heart disease seen in humans. Acrolein is of particular concern because it is considered to be the main contributor to the increased risk of cardiovascular disease among cigarette smokers, he says.

For 12 weeks, the animals were exposed to traditional cigarette smoke and an e-cigarette aerosol at two concentrations of nicotine, ten and 36 milligrams per milliliter, which spans the range of nicotine usually found electronic cigarette juices. The mice were also exposed to acrolein by itself at 0.5 and 1 parts per million (levels typically found in cigarette smoke). Lastly, a group of mice were exposed to just nicotine in water.

One puff of an e-cigarette is likely less toxic than a traditional cigarette, but we don’t know how many puffs the typical e-cigarette user is taking.

Unsurprisingly, standard cigarette smoke had greatest effect, increasing atherosclerosis risk about three times over the baseline. Oral nicotine doubled atherosclerosis risk, while acrolein “seemed to have a dose dependent increase” with risk doubling at higher levels. E-cigarettes seemed to also have a dose dependent result. At the higher concentration, 36 milligrams per milliliter of nicotine, the e-cigarette aerosol doubled the risk of atherosclerosis. Even nicotine alone appeared to induce atherosclerosis acceleration in mice, Conklin noted.

Although he stresses the limitations of one experiment performed on mice, they are cause for concern. He also stresses that how these products are used changes rapidly. For example, some e-cigarettes can be tweaked to deliver more vapor. “There is some concern that we don’t really know how much aldehyde like acrolein is being generated by these modifiable electronic cigarettes.”

How e-cigarettes are used also adds to the confusion. While there is decades worth of data on how a traditional cigarette is smoked, there is little consistency in how e-cigarettes deliver nicotine and flavor compounds. One study found that these products might deliver different levels of nicotine during each use and there were significant differences between “labeled and true levels” of nicotine in juices. One puff of an e-cigarette is likely less toxic than a traditional cigarette, but it’s not known how many puffs the typical e-cigarette user is taking.

“We don’t really know what that frequency does to the health outcome,” Conklin says.

**Thousands of Flavors**

Back at Vapor Worx, Beckmann tells me that she used to smoke real cigarettes “for the calming effect more than anything,” she says. “I can’t really say that I enjoyed the flavor of it.”

Just as there is no standard use pattern for e-cigarettes, it’s impossible to a pin down a single taste preference for vaping. There are thousands of different flavors, ranging from those that mimic a cigar to bubblegum or blueberry.

When Beckmann was able to switch to e-cigarettes, she found the fruity flavors “more enjoyable,” she says. “For my dad it was the opposite. It just depends on each individual.”

The profusion of flavors further complicates the public health picture. Though the different flavors are approved by the FDA as safe for consumption, the environment in the stomach is very different from the lungs.

Take popcorn flavoring, for example. Back in 2000, eight workers from a microwave popcorn processing plant became sick with severe lung disorder, later dubbed “popcorn lung.” A subsequent investigation linked their sickness to airborne exposure to butter flavoring chemicals including diacetyl, which is used in a variety of food products. How diacetyl and similar compounds might damage lungs isn’t understood, but it one hypothesis suggests that these chemicals impair the function of immune cells in the respiratory system. Regardless, the chemical is now categorized under OSHA regulations as an “inhalation hazard.”

Flavor compounds could suppress immune function more broadly than cigarettes.

Beckmann is aware of the dangers of diacetyl, and she says that flavor makers are phasing it out, and if they’re not, they’ll have disclaimers. “We stay away from it.”

Yet avoiding those compounds may be difficult. In a study published last year, scientists at Harvard School of Public Health detected diacetyl in 39 out of 51 e-cigarette flavors tested, including flavors one wouldn’t associate with popcorn, such as “menthol” and “tobacco.”

In one recent experiment, scientists examined the effect of cinnamon flavored e-cigs containing cinnamaldehyde on tissue cells from smokers’ nasal cavities. The cinnamaldehyde-containing e-liquids seemed to compromise the function of immune cells such as macrophages, natural killer cells, and neutrophils. The same researchers, led by toxicologist Ilona Jaspers at the University of North Carolina, also took tissue samples from non-smokers, cigarette smokers, and e-cig users to study the impact of smoke and vapor on immune gene function. As expected, smokers’ samples showed suppression of immune genes in the nasal mucosa. E-cig users not only had the same immune gene changes, but they also showed suppression of additional immune genes, suggesting that the flavor compounds could suppress immune function more broadly than cigarettes.

For scientists it just adds the growing list of unknowns. There are over 7,000 flavors right now and several hundred e-cig products and probably hundreds more if you include modified versions, Conklin says. Combined with how frequently people are vaping, he adds, “it’s not clear at all how that influences that toxicity.”

**Kicking the Habit**

If vapor devices were just used to transition away from cigarettes, they might not cause as alarm among public health researchers. But the products are also quickly becoming popular with young people who don’t smoke at all. A recent survey from the CDC found that 32% of high schoolers reported trying cigarettes, while 45% have used electronic vapor products.

The new regulation from the FDA should help keep vapor devices away from teenagers, but what’s less clear is if the laissez-faire vaping culture helps or hinders more people trying to quit cigarettes.

Despite stories like Beckmann’s, “for most people, they inhibit quitting,” Glantz says.

I found my way to Beckmann’s shop because, like her, I wanted to help my father kick his pack-a-day habit. But, then I wondered: if he succeeds in switching from a pack of cigarettes to hundreds of daily puffs of a cigar-flavored vapor, will that make a notable dent in his cardiovascular health?

So far, it’s a moot point because he has yet to try the vapor products we bought him months ago. And therein lies the problem: everyone’s addiction and smoking preferences are different.

Methods for quitting cigarettes can vary widely by the individual, but those who are using smoking cessation devices found more success when part of a counseling program, Glantz says. “It may be that informal use of nicotine replacement keeps people smoking, as opposed to when it’s consciously being used as part of a supportive smoking cessation effort.”

Glantz might not be as concerned if the vaping trend only included local shops like Vapor Worx. But Big Tobacco companies are putting their muscle into marketing, putting vaping in front of a much broader audience. At that shop, clients and the employees are dubious of any Big Tobacco products. The shop even sources some of its juices and e-cigarette “boxes” locally. The FDA regulations will likely change that, though. The big companies may be all that’s left standing, since they can afford to register their ingredients with the agency.

No matter who manufactures or sells e-cigarettes, the end result is the same. “You’re inhaling hot aerosol ultra-fine particles, aldehyde and nicotine,” Glantz says, “and that’s not so good.”

“There’s a lot we don’t know about e-cigarettes,” he adds. “But I think we already know enough to know that they are less dangerous than a cigarette, but they’re not safe.”