

Potentially dangerous molecules detected in e-cigarette aerosols

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Electronic cigarettes produce highly-reactive free radicals—molecules associated with cell damage and cancer—and may pose a health risk to users, according to researchers at Penn State College of Medicine.

The use of [e-cigarettes](#) is on the rise. According to the Centers for Disease Control and Prevention, more than 20 percent of young adults

have tried e-cigarettes, and current smokers and recent former smokers are most likely to have used them.

E-cigarettes deliver nicotine in water vapor instead of by burning tobacco. The battery-operated devices have been marketed as an alternative to traditional cigarettes.

Despite their growing popularity, very little is known about toxic substances produced by e-cigarettes and their [health effects](#).

"There's a perception that e-cigarettes are healthier than regular cigarettes, or at least not as harmful as regular cigarettes," said John P. Richie Jr., professor of public health sciences and pharmacology. "While e-cigarette vapor does not contain many of the [toxic substances](#) that are known to be present in cigarette smoke, it's still important for us to figure out and to minimize the potential dangers that are associated with e-cigarettes."

Previous studies have found low levels of aldehydes, chemical compounds that can cause [oxidative stress](#) and cell damage, in e-cigarette "smoke." But until now, no one has looked for free radicals, the main source of oxidative stress from cigarette smoke. Highly reactive free radicals are a leading culprit in smoking-related cancer, cardiovascular disease and chronic [obstructive pulmonary disease](#).

Instead of smoke, e-cigarettes produce aerosols, tiny liquid particles suspended in a puff of air. The researchers measured free radicals in e-cigarette aerosols.

They found that e-cigarettes produce high levels of highly reactive free radicals that fall in the range of 1,000- to 100-times less than levels in regular cigarettes.

"This is the first study that demonstrates the fact that we have these highly reactive agents in e-cigarette aerosols," Richie said. Results were published in the journal *Chemical Research in Toxicology*.

"The levels of radicals that we're seeing are more than what you might get from a heavily air-polluted area but less than what you might find in [cigarette smoke](#)," Richie said. The radicals are produced when the device's heating coil heats the nicotine solution to very high temperatures.

Further research is needed to determine the health effects of highly reactive free radicals from e-cigarettes.

"This is the first step," Richie said. "The identification of these radicals in the aerosols means that we can't just say e-cigarettes are safe because they don't contain tobacco. They are potentially harmful. Now we have to find out what the harmful effects are."

Richie is currently conducting studies to carefully measure total numbers of [free radicals](#) in e-cigarette aerosols and to identify their chemical structures.

"That will help us interpret the data better to know how dangerous they are," he said.

More information: Reema Goel et al. Highly Reactive Free Radicals in Electronic Cigarette Aerosols, *Chemical Research in Toxicology* (2015). [DOI: 10.1021/acs.chemrestox.5b00220](https://doi.org/10.1021/acs.chemrestox.5b00220)

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