Health risks of e-cigarettes emerge

Vaping pollutes lungs, may protect antibiotic-resistant bacteria

BY JANET RALOFF

Electronic cigarettes, marketed as safer than regular cigarettes, deliver a cocktail of toxic chemicals, including carcinogens, into the lungs, new studies show. Using e-cigarettes may even promote antibiotic-resistant bacterial infections.

Engineers developed e-cigarettes several years ago to provide tobacco users a smoke-free source of nicotine. The devices heat up a liquid that a user inhales, or "vapes." Because e-cigarettes burn nothing, they release no smoke.

"There's no question that a puff on an e-cigarette is less toxic than a puff on a regular cigarette," says Stanton Glantz, director of the Center for Tobacco Control Research and Education at the University of California, San Francisco. But few studies have looked at the vapors' toxicity. So scientists have been circumspect about describing e-cigarettes as safe.

Glantz and his team reviewed data on inhaling vapors and found more risk than scientists had thought. E-cigarettes deliver high levels of nanoparticles, the researchers wrote May 13 in *Circulation*. Those particles have been linked to asthma, stroke, heart disease and diabetes (*SN: 7/18/09, p. 26*). The levels "really raise concerns about heart disease and other chronic conditions where inflammation is involved," he says.

E-cigarettes are no longer niche products. Vaping product sales last year were projected to hit $1.7 billion, report Ii-Lun Chen and Corinne Husten of the Food and Drug Administration in a special May issue of *Tobacco Control*. At least 1 in 5 smokers have tried e-cigarettes, as have 10 percent of U.S. high school students, according to the Centers for Disease Control and Prevention.

The FDA has seen no data establishing that vaping is safe, writes the agency's Priscilla Callahan-Lyon in *Tobacco Control*. She reviewed data from 18 studies on e-cigarette vapors and found that most contain at least traces of the solvents in which nicotine and flavorings had been dissolved. Those solvents, known as lung irritants, can transform into something even more worrisome: carbonyls. Carbonyls include cancer-causing chemicals, such as formaldehyde, and suspected carcinogens, such as acetaldehyde.

Early e-cigarettes didn't deliver the powerful hit of nicotine that burning tobacco does. So engineers developed technology that allows users to increase an e-cigarette's voltage, and thus temperature, to atomize more nicotine per puff.

But the higher temperatures also can trigger a thermal breakdown of the solvents, producing the carbonyls, explains Maciej Goniewicz of the Roswell Park Cancer Institute in Buffalo, N.Y. If users of second-generation e-cigarettes maximize the power on their devices while using vaping liquids containing a solvent mix of glycerin and propylene glycol, formaldehyde levels can reach those found in tobacco smoke, his team reports May 15 in *Nicotine & Tobacco Research*.

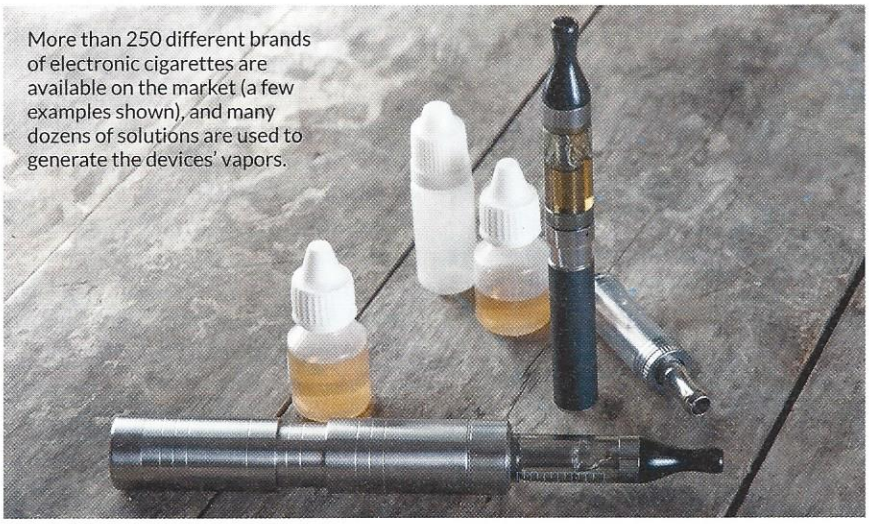
Such compounds are mainly a concern if they make it all the way into the lungs. Vapers can inhale huge numbers of very small aerosol particles into the lung's tiniest airways. The median diameter of vaping particles falls around 200 to 300 nanometers, based on unpublished data from Jonathan Thornburg and others at RTI International in Research Triangle Park, N.C. That size "is right in line with conventional tobacco smoke," he says.

The mass of nanoparticles in the vapors is about 3 milligrams per cubic meter of air, he found, or about 100 times as high as the Environmental Protection Agency's 24-hour exposure limit for fine air particles. RTI predicts that 40 percent of these inhaled particles would deposit in the lungs' smallest airways.

In addition to nicotine and solvents, vapors also contain chemical flavorings and food preservatives from the vaping liquid. Although they may be "generally recognized as safe" by FDA, Thornburg says, the designation is based on tests of the compounds when they are ingested. "No one has considered their safety when it comes to inhalation," he says.

E-cigarette vapors can even make dangerous germs harder to kill, Laura Crotty Alexander reported May 18 at an American Thoracic Society meeting in San Diego. When Crotty Alexander, of the VA San Diego Healthcare System, exposed methicillin-resistant *Staphylococcus aureus* (known as MRSA) to e-cigarette vapors, these antibiotic-resistant bacteria proved harder to kill.

"We started these studies so that we could advise ... patients on whether they should try switching to e-cigarettes," she says. "My data now indicate they might be the lesser of the two evils. But e-cigarettes are definitely not benign."



More than 250 different brands of electronic cigarettes are available on the market (a few examples shown), and many dozens of solutions are used to generate the devices' vapors.

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