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Electronic-Cigarettes: Health Impacts and Emerging Policy Implications

The use of electronic cigarettes (e-cigarettes) has increased dramatically. Adolescents and young adults have been hospitalized for acute lung injury from inhaled chemicals. The severity of the associated pulmonary disease has garnered attention from health care providers and policymakers have started considering widely implementing bans on e-cigarette additives across the United States. As of August 27, 2019, the Center for Disease Control and Prevention (CDC) reported 215 possible cases of acute lung disease caused by e-cigarette use. The vapor can contain harmful substances such as heavy metals, lead, ultrafine particles and volatile organic compounds ¹. Inhalation of these chemicals are thought to result in a severe pulmonary disease-associated inflammation, pleuritic chest pain, bilateral infiltrates, and ground-glass opacities ¹⁻⁴. Patient symptoms typically occurred gradually and included hypoxia, difficulty breathing, shortness of breath, mild to moderate gastrointestinal symptoms, tachycardia, fevers, and fatigue, and chest pain ². There have been 127 reported cases of seizure or neurological defects among e-cigarettes users. Tetrahydrocannabinol (THC) vapors are thought to be related to three fatalities ^{2,4}; vitamin E acetate, an additive to the THC in e-cigarettes, could be contributing to illness ⁴. No single substance has been directly linked to the pulmonary disease¹.

There has been an alarming increase in e-cigarette use over the last several years; highest among young adults and current cigarette smokers. E-cigarettes became popular in the United States in 2006 ⁵ and have resulted in \$3.5 billion in sales between 2010 to end of 2015 ⁶. Roughly 18% of Americans smoke, with e-cigarettes comprising 10.8% ^{6,7}. In 2018, nearly 1 in 4 high schoolers and 1 in 14 middle

school students in the United States reported current use of a tobacco product. In 2018, 3.6 million high school and middle school students reported e-cigarette use ⁸.

E-cigarettes are vaporizers used to inhale nicotine, added flavors, and other chemicals. The atomizer heats liquid by either pressing a button or by inhaling. Pod-mod devices, also known as JUUL[®], are more inconspicuous due to the size and are often favored among adolescents. JUUL[®] e-cigarettes contain high amounts of nicotine; one “pod” has a similar amount of nicotine as 20 conventional cigarettes ⁹. Researchers continue to study the long-term effects of vapor inhalation on pulmonary structures and function.

Vapor inhalation from e-cigarettes can damage the cilia in the lungs. Preventing mucociliary clearance often leads to bronchitis, cough, wheeze, and restrictive lung disease ^{10,11}. Bronchiolitis obliterans, or “popcorn lung”, is a serious and irreversible lung disease that can result in alveolar scarring, obstruction of the small airways, cough, and shortness of breath. This is thought to be caused by inhalation of diacetyl, a known compound in e-cigarettes ¹².

Defenders of e-cigarettes argue there is harm reduction when compared to traditional tobacco products; however, the recent hospitalizations seem to disprove that argument. Long-term risks associated with e-cigarette use are not fully understood. Nicotine exposure in adolescents can lead to toxicity, addictions, and lasting effects such as mood disorders, attention issues, and lowered impulse control ⁹. Furthermore, smokers often use e-cigarettes to aid in cessation; there is limited evidence to support this and should not be encouraged by health care providers. The US Food and Drug Administration (FDA) recommends licensed nicotine replacement therapies such as Nicorette products or oral treatment for smoking cessation ⁷.

In 2016, the FDA was granted regulatory authority over all tobacco products, but there is a lack of oversight of the e-cigarette additives. The Surgeon General recommended banning e-cigarettes in closed spaces due to the unknown harm that secondhand smoke exposure may cause ¹³. Because of this, 13 states have banned the use of e-cigarettes in public places ¹⁴. In July 2019, San Francisco was the first

city to ban the sale of e-cigarettes ¹⁵. The use of e-cigarettes in public continues to be controversial. There is limited knowledge regarding the long-term health effects of second-hand vapor exposure.

Regulations on e-cigarettes continue to evolve. In September 2019, the Trump administration announced a ban on flavored e-cigarettes as federal health officials call for restrictions and increasing FDA oversight ¹⁶. The CDC is asking consumers to refrain from using e-cigarettes and is conducting a multistate investigation into exposures. Data from adverse events, at time of occurrence, are being collected. Epidemiological, behavioral, and laboratory evidence is being analyzed on a case by case basis. Clinicians are being encouraged to question e-cigarette use in cases of acute respiratory distress with abnormal radiologic findings and systemic symptoms. If e-cigarette use is suspected, a focused history needs to be obtained and documented. Any remaining e-cigarette paraphernalia requires testing for chemical components and additives¹.

In conclusion, e-cigarettes are not a healthy tobacco alternative. CDC is recommending consumers refrain from e-cigarettes. Many adolescents and young adults have developed severe lung injury secondary to vaping related illness. Numerous deaths have been reported. Considering the recent vaping induced lung injury and associated fatalities, timely data collection of clinical characteristics is vital. Research is needed to study e-cigarette additives, systemic effects, and long-term pulmonary consequences.

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