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⊗ Vaping-induced Acute Lung Injury: An Epidemic That Could Have Been Prevented

The epidemic of vaping-related acute lung injury is a public health disaster. As of October 3, 2019, the CDC had received reports of 1,080 lung injury cases from 48 states and one U.S. territory, with 18 deaths confirmed in 15 states (1). Almost 80% of the cases are younger than 34 years of age, with 38% younger than 21 years. Many, but not all, of the cases involved vaping of products containing tetrahydrocannabinol (THC). The research letter by Triantafyllou and colleagues (pp. 1430–1431) in this issue of the *Journal* describes the features of six cases seen this past summer at the University of Pittsburgh Medical Center (2).

The cases are emblematic of those reported to the CDC. They were young men who presented with respiratory and gastrointestinal complaints who reported regular use of vaporized cannabis and nicotine products. The patients showed evidence of a systemic inflammatory response with leukocytosis, and chest imaging showed bilateral, multifocal ground-glass opacifications. The patients were treated with antibiotics until cultures came back as negative, and most patients received corticosteroids. Two of the

patients required mechanical ventilation. Fortunately, no one died. The case descriptions from the University of Pittsburgh team are similar to those of a larger case series published earlier this year (3).

One common finding in the two published case series is the prevalence of use of a cannabis product known as “Dank Vape.” What are Dank Vapes? According to the CDC, Dank Vapes are the most prominent in a class of largely counterfeit brands, with common packaging that is easily available online and used by distributors to market THC-containing cartridges (4). Public health officials in Wisconsin and Illinois, two of the states hit hardest by the vaping-related acute lung injury epidemic, interviewed 86 patients, and 66% said they had used THC products labeled as Dank Vapes (4). Most (89%) of the THC-containing products used by the patients were obtained from friends, family, school, dealers, or off the street. Interestingly, most of the patients used universal “vape pens” for which prefilled THC cartridges can be used, as opposed to the closed pod devices sold for proprietary nicotine-containing products (e.g., JUUL). Use of devices with a tank designed to be filled with nicotine-containing liquid or THC oil was reported by 18 (21%) patients, and 14 (16%) reported aerosolizing THC concentrates by “dabbing,” a process involving vaporizing extracts of a concentrate (often butane hash oil) that has been placed on a hot surface.

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Although the CDC investigation suggests that a clue to the vaping lung injury epidemic lies in the Dank Vapes products, the causative agent(s) remains unknown. Public health investigators in New York State suggested that vitamin E acetate added as a thickening agent to THC-containing extracts, including Dank Vapes (users apparently see thicker extracts as more potent), may be responsible for lung injury, after 34 samples of extracts used by injured patients all contained it (5). However, other extracts tested used by cases in other states have not confirmed the universal presence of vitamin E acetate (6). Because virtually all THC-containing extracts are oily, lipoid pneumonia also has been suggested as the responsible pathophysiology (7, 8), and some but not all BAL fluid from patients has shown the presence of lipid-laden macrophages (2, 3). It is important to note that some patients with lung injury only used nicotine-containing products (3).

Triantafyllou and colleagues describe several possible mechanisms by which vaping can lead to acute lung injury (2). The common vehicles of the nicotine-containing extracts are propylene glycol and glycerin, which have been shown to induce airway remodeling (9). Nicotine vapor itself has been shown to induce macrophage activation (10), and flavoring additives, including the known respiratory toxin diacetyl, lead to the generation of byproducts that directly injure the airway epithelium (11). It is really no surprise to anyone with a background in inhalational toxicology that when chemically complex extracts are heated to the point of aerosolization and vaporization, toxic agents will be generated (12). A recent paper from the Mayo Clinic that described the pathological examination of lung biopsies from 17 patients with vaping-associated lung injury reported findings more consistent with airway-centered chemical pneumonitis from one or more inhaled toxic substances, rather than lipoid pneumonia (13).

Although the CDC, in concert with state public health officials, feverishly works to find the “bad actor or actors” in vaping extracts, it has also taken steps to warn the public of the dangers of vaping, especially of THC-containing extracts. The CDC recommends that current users consider refraining from using e-cigarette, or vaping, products, particularly those containing THC (1). The agency also recommends that youth and young adults not use e-cigarettes or vaping products and that these products not be bought off the street or modified in any way. The negative publicity surrounding e-cigarettes has caused the company with the largest share of the market, JUUL, to stop all advertising, end internet sales of flavored e-cigarettes, and drop its well-funded political campaign (Proposition C) to skirt San Francisco’s legislative ban on sales of e-cigarettes. JUUL’s CEO recently resigned, to be replaced by an executive from Altria, the tobacco company that owns 35% of JUUL.

The tragic epidemic of lung injury due to vaping was preventable. If the U.S. Food and Drug Administration (FDA) had taken a more proactive approach to regulation of e-cigarettes as electronic nicotine delivery devices similar to nicotine patches or gum, there would likely have been much less use by America’s youth. Data from the 2019 Monitoring the Future Survey conducted annually by the National Institute on Drug Abuse showed a doubling of the percentage of teens who reported vaping, with 25% of high school seniors reporting use in the last month (14). Rather than take regulatory action that could have protected the nation’s youth, the FDA abdicated its responsibility (15, 16) and let corporate profits come before public health. A cardinal tenet of environmental health is the precautionary principle that holds when a new product is developed

that may have the potential for harm, it should be tested carefully for toxicity before being widely marketed. The FDA was made aware of the potential harm of inhaling vapors of nicotine-containing aerosols but allowed tobacco company–funded companies like JUUL to market flavored e-cigarette pods, which has led to the nicotine addiction of thousands of children. Use of nicotine-containing e-cigarettes is likely a gateway to vaping THC-containing extracts. There is a powerful lesson here. Ignore the precautionary principle at society’s peril. Lives have been lost through this ignorance. ■

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