

E-cigarette or vaping product use-associated lung injury (EVALI)

In 2019, the US Centers for Disease Control (CDC) reported an epidemic of “severe lung disease” caused by vaping. This illness was referred to as VAPI—vaping associated pulmonary illness and is now called EVALI—E-cigarette or vaping product use-associated lung injury. The observed patterns of disease are variable but all have been associated with recent electronic cigarette use or “vaping.” Vaping is a word used to describe the use of an electronic system to deliver inhaled drugs, most commonly nicotine and cannabinoids (natural or synthetic forms of marijuana)¹. Juuling is another term that is used to describe the use of a specific vape device. This fact sheet reviews lung injuries associated with vaping.



Vaping devices first entered the US market in 2006 and have been aggressively marketed. Most of these devices do not resemble tobacco products but rather have the appearance of everyday use materials such as pens and USB flash drives which are both easy to carry and hide. See the ATS Patient Education series fact sheet for more information on the risks of electronic nicotine delivery systems² at www.thoracic.org/patients. Some believe that vaping is safer than traditional cigarettes, but the short- and long-term health effects of vaping are increasingly worrisome.

Clinical Presentation

Patients with EVALI have presented with a range of symptoms, including shortness of breath, fever, cough, vomiting, diarrhea, headache, dizziness and chest pain following the use of vaping devices. Symptoms typically worsened over a period of days to weeks before patients were seen by a healthcare provider, and were consistent with chemical pneumonitis. Many patients have required hospitalization, and several have required ICU-level care with mechanical ventilation due to severe respiratory failure. In 2019, at least six deaths were attributed to EVALI. Many of the cases were associated with tetrahydrocannabinol and other flavorants added to e-cigarette devices.

Pathophysiology

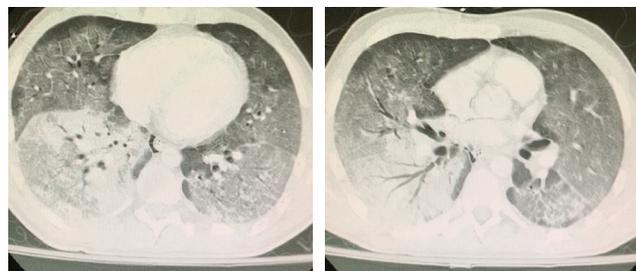
The etiology of EVALI is as yet unknown, but it does not appear to be infection-mediated. There are multiple compounds present in vaporized material that could potentially cause injury such as flavorants (e.g. diacetyl, a chemical linked to serious lung disease); volatile

organic compounds; and heavy metals (e.g. nickel, tin, and lead). The U.S. Food and Drug Administration’s Center for Tobacco Products is analyzing product samples from vaping devices across multiple states to identify any potentially harmful constituents that may be triggering the illnesses. EVALI has been reported with a range of vaping devices and liquids; no one specific liquid or device has been identified as the causative agent. EVALI has been reported with nicotine, tetrahydrocannabinol (THC) and cannabidiol (CBD) products.

Laboratory findings and Imaging

Associated lab findings in patients with VAPI are variable and non-specific. They include elevated white blood cell count and erythrocyte sedimentation rate. CT imaging demonstrates infiltrates in both lungs (Layden J. E. et al NEJM 2019)³. Bronchoscopy with BAL most commonly demonstrates neutrophilia and sparse to moderate lipid laden macrophages by Oil Red O staining or Sudan staining.

Figure 2: CT findings of a patient with acute EVALI



CT Imaging from EVALI courtesy of Dr. Shreyes Boddu, University of Oklahoma, with patient consent to use images

Diseases Associated with EVALI

The following patterns of lung injury have been reported with VAPI:

- Acute eosinophilic pneumonia
- Lipoid pneumonia
- Acute lung injury and acute respiratory distress syndrome
- Acute and subacute hypersensitivity pneumonitis
- Organizing pneumonia
- Acute eosinophilic pneumonia
- Diffuse alveolar hemorrhage
- Respiratory bronchiolitis-associated pneumonitis

Treatment

Based on limited experience to date, treatment with corticosteroids may improve symptoms in some cases. In addition, clinicians should seek to identify other causes of illness (e.g. infections) that may be contributing to the clinical presentation. Clinicians should inquire specifically about e-cigarette use in any patient presenting with acute lung disease. In patients suspected of EVALI, whom are candidates for bronchoscopy, it may be helpful to perform bronchoscopy with BAL for submission of samples for Oil Red O or Sudan staining and further infectious work-up to rule out other etiologies. The CDC also recommends that clinicians report cases of EVALI to their state or local health department, as well as the FDA at <https://www.safetyreporting.hhs.gov/SRP2/en/Home.aspx?sid=cc7873df-0590-49ec-9d71-ecbf742d34e3> and collect the following information⁴:

- Type of device(s) used (e.g. bottles, cartridges or pods)
- Specific type(s) of liquid used (e.g. nicotine, THC products, flavored fluids)
- Were devices, liquids, refill pods and/or cartridges shared with other people?
- Were old cartridges or pods reused with other homemade or commercial products?
- Were devices used to inhale drugs that were concentrated by heating prior to vaping (i.e., “dabbing”)
- Details of vaping behavior (e.g. cloud volume, frequency of puffs, ‘zero’ or ‘stealth’ vaping, valsalva at end inhalation).

Contacting the CDC

The CDC is actively assisting state health departments with their epidemiological and laboratory investigations by facilitating information sharing between state health departments, providing assistance in the development of data collection tools and health communication materials, and identifying options to facilitate laboratory testing of

vaping products and solutions. Public health officials can discuss possible cases, receive guidance on laboratory testing, and obtain assistance with epidemiological investigations by emailing: VapingAssocIllness@cdc.gov.

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Rx Action Steps

- ✓ Report all suspected cases to CDC.
- ✓ Screen all patients for the use of tobacco and vaping devices.
- ✓ Offer smoking and vaping cessation counseling to all patients who report use.
- ✓ Support enforcement of the federal law banning sale of vaping or tobacco products to anyone under age 21 years.
- ✓ Support stronger penalties for retailers who illegally sell tobacco, nicotine, and vaping devices to minors.
- ✓ Encourage the FDA and Congress to ban all flavors in tobacco and nicotine products including menthol.
- ✓ Support research on prevention and cessation strategies for smoking and vaping.

Healthcare Provider’s Contact Number:

References/Additional Resources:

1. **CDC electronic Cigarettes**
 - https://www.cdc.gov/tobacco/basic_information/e-cigarettes/index.htm
2. **ATS Patient Education: Vaping/Electronic Nicotine Delivery Systems**
 - <https://www.thoracic.org/patients/patient-resources/resources/vaping-electronic-nicotine-delivery-systems.pdf>
3. **Layden J.E. et al NEJM 2019**
 - Abstract: <https://www.nejm.org/doi/full/10.1056/NEJMoa1911614>
4. **CDC Clinician Outreach and Communication Activity**
 - <https://emergency.cdc.gov/newsletters/coca/081619.htm>

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