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. Here we review what is known about VAPI. The ATS Patient Education series previously published a review document highlighting the risks of electronic nicotine delivery systems. Some believe that vaping is safer than traditional cigarettes, but the short- and long-term health effects of vaping are increasingly worrisome.

Clinical Presentation
To date, the CDC has reported an epidemic of “severe lung disease” caused by vaping. Patients 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. As of September 16th 2019, the CDC has confirmed six deaths attributed to VAPI, and is evaluating over 350 cases.

Pathophysiology
The etiology of VAPI 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. VAPI has been reported with a range of vaping devices and liquids; no one specific liquid or device has been identified as the causative agent. VAPI 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. 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 VAPI

CT Imaging from VAPI courtesy of Dr. Shreyes Boddu, University of Oklahoma, with patient consent to use images.
Diseases Associated with VAPI
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 VAPI, 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 VAPI to their state or local health department, as well as the FDA at [https://www.safetyreporting.hhs.gov/SRP2/en/Home.aspx?id=cc7873df-0590-49ec-9d71-ecbf742d34e3](https://www.safetyreporting.hhs.gov/SRP2/en/Home.aspx?id=cc7873df-0590-49ec-9d71-ecbf742d34e3) and collect the following information:
- 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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References/Additional Resources:
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2. ATS Patient Education: Vaping/Electronic Nicotine Delivery Systems
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