

E-Cigarette, or Vaping, Associated Lung injury

The CDC, the FDA, state and local health departments, poison centers and others are investigating a multistate outbreak of **lung** injury associated with use of **e-cigarette** or **vaping** products. As of October 8, 2019, there have been 1,299 cases in the U.S. (29 in Maryland) with 26 deaths reported from 21 states. Approximately 80% of patients are <35 years old; 15% are <18 years old and 21% are 18-20 years old.



E-cigarettes were introduced into the U.S. market in 2007. E-cigarettes differ from traditional cigarettes in that they are tobacco-less and heat up a solution cartridge which volatilizes the liquid into a vapor form. This process of heating a refillable solution into a vapor brings about various possible mechanisms as to the cause of this sudden increase in e-cigarette, or vaping, associated lung injury (EVALI). The first theory relates to the newer e-cigarette devices that have the ability to heat the solution to a higher temperature, volatilizing substances in greater quantity that was not achievable with the lower temperatures (*Sleiman M. *Envir Sci Tech* 50.17; 2016:9644-9651*). Another possible mechanism would be vaping of substances previously not available in the market such as THC. Among reported cases, 76% of patients recount vaping of THC creating a possible association of THC products and EVALI (*Layden JE. *N Engl J Med* Sep 6 2019*). However, THC has been available as a vaping solution for many years in some states, and does not fully explain the sudden increase nationwide. The prevailing theory has been adulteration of off market vaping solutions.

Products such as “Dank Vapes” and “TKO” are homemade vaping products that are frequently sold alongside legitimate products, and have been involved in 53% of EVALI cases (*Layden JE. *N Engl J Med* Sep 6 2019*). Patients who use e-cigarettes report testing the validity of the solution via the bubble test. This bubble test involves turning the cartridge/vial to assess the viscosity of the solution by looking at the movement of the air bubble. As counterfeit products have a lower viscosity, the air bubble in these solutions moves more quickly than traditional solutions. In an attempt to give the appearance of legitimacy, counterfeit solutions have been incorporating thickening agents such as vitamin E oil (diacetyl), a compound previously found in butter flavorings associated with popcorn lung disease (*Simoes E. *MMWR* April 26 2002;51.16:345*). These lipophilic compounds entering the lung can interfere with the surfactant in the lung tissue and may explain the pathologic findings such as lipoid pneumonia, lipid-laden macrophages, and hypersensitivity pneumonitis (*Maddock S. *N Engl J Med* Sep 6 2019*).

The CDC has developed criteria that help to diagnose an EVALI case that incorporates vaping in the past 90 days, pulmonary infiltrates on imaging, and negative infectious workup (*Siegel D. *MMWR* Oct 11 2019;68:787-790*). Clinical findings of EVALI include a gradual onset of respiratory symptoms (cough, shortness of breath) over days to weeks, GI symptoms (pain, nausea, vomiting), and systemic symptoms (fatigue, fever, weight loss). Treatment is largely supportive. Patients often require oxygen therapy and can worsen acutely progressing to respiratory failure and ARDS requiring intubation and extracorporeal membrane oxygenation. Inevitably, many of these patients will receive moderate to high-dose corticosteroids as seen in the recent review of Wisconsin and Illinois cases with anecdotal reports of benefit (*Layden JE. *N Engl J Med* Sep 6 2019*).

Faisal Syed Minhaj, Pharm.D.
Clinical Toxicology Fellow

Did you know?

In Maryland, clinicians must report all cases of suspected e-cigarette, or vaping, associated lung injury to their local health department within 1 business day.

This order can be found at <https://phpa.health.maryland.gov/OEHFP/EH/Pages/VapingIllness.aspx>.

All healthcare professionals should refer to the CDC's criteria for diagnosis at https://www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease/healthcare-providers/index.html.