

EVALI

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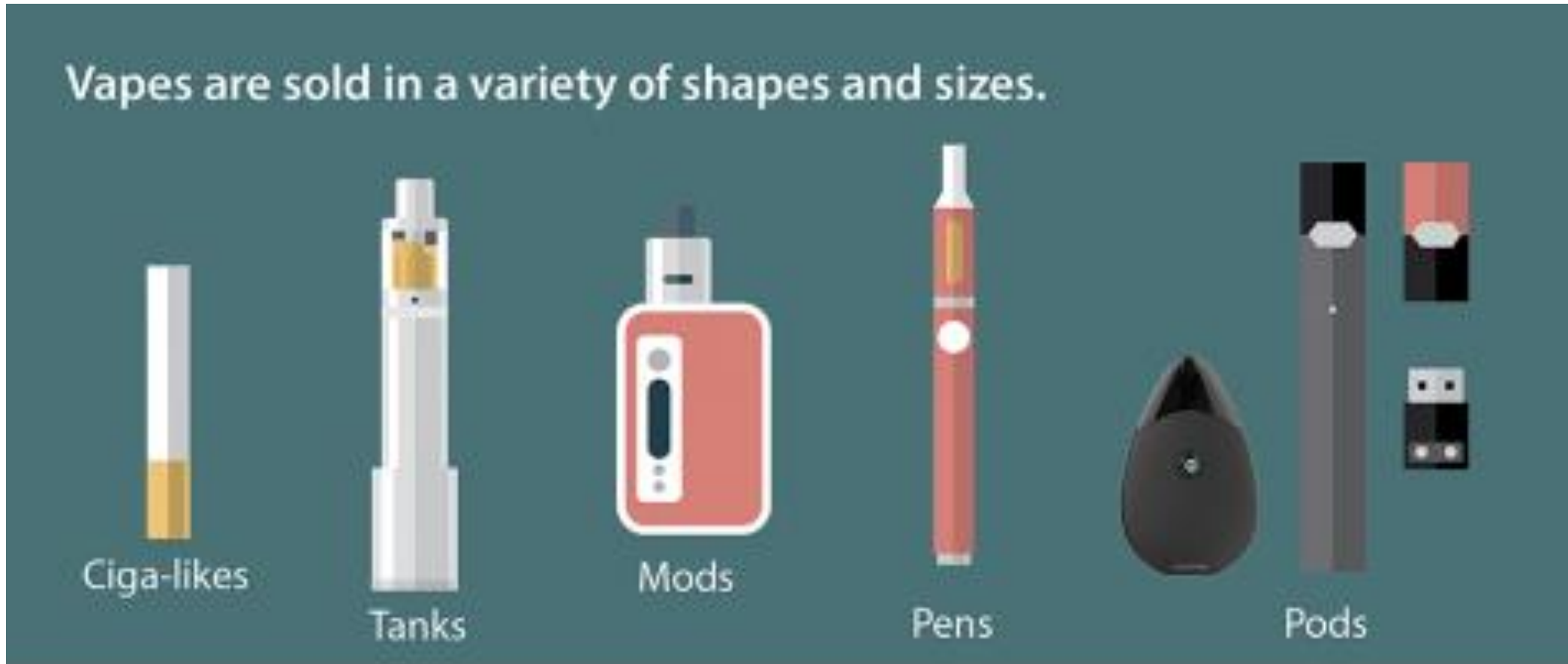
Disclosures

- None

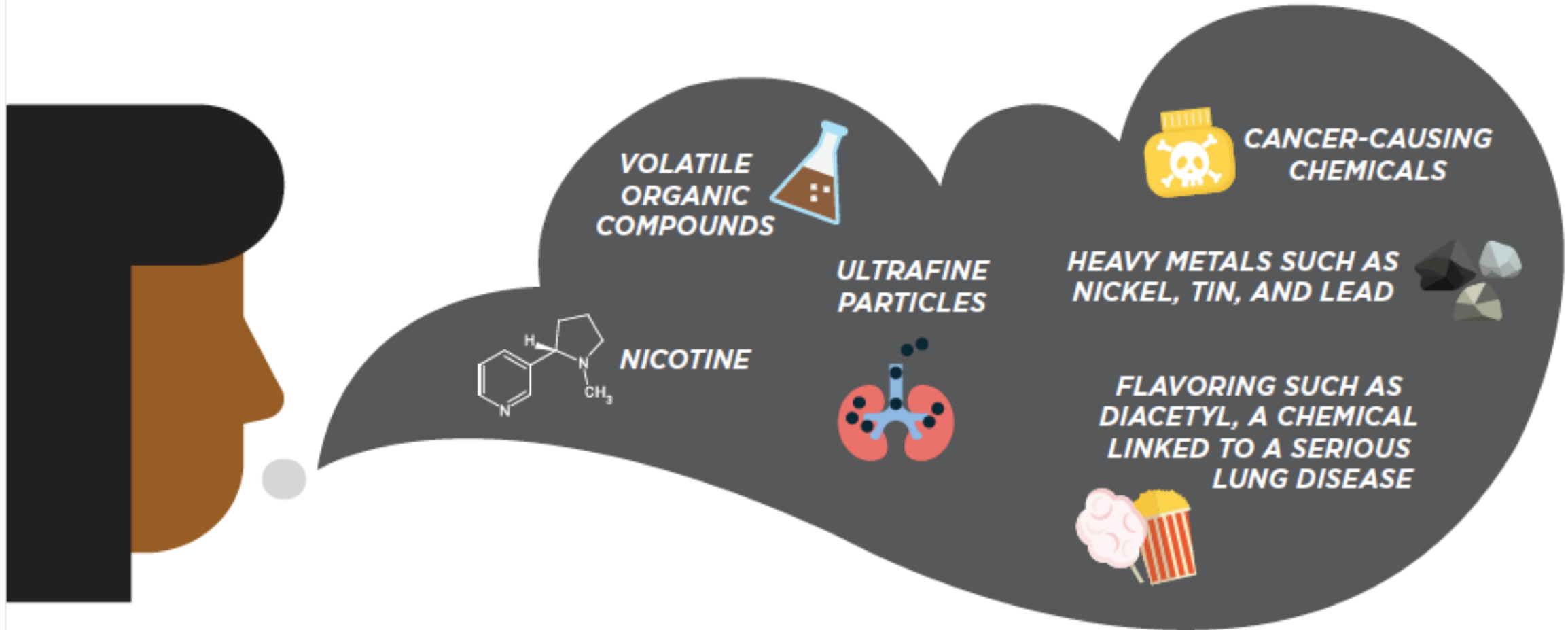
Objectives

- Review of vaping products and content
- Pathophysiology of vaping-induced lung injury
- Types of lung injury
- Symptoms and diagnosis
- Treatment
- Outcomes

Vaping products

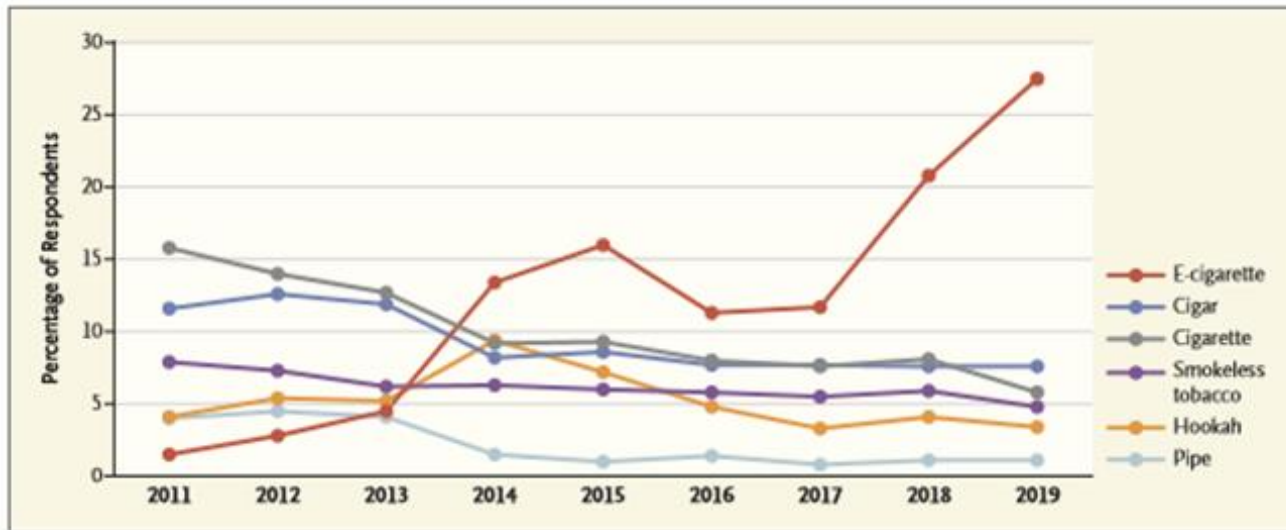


What is being inhaled?



Increasing usage

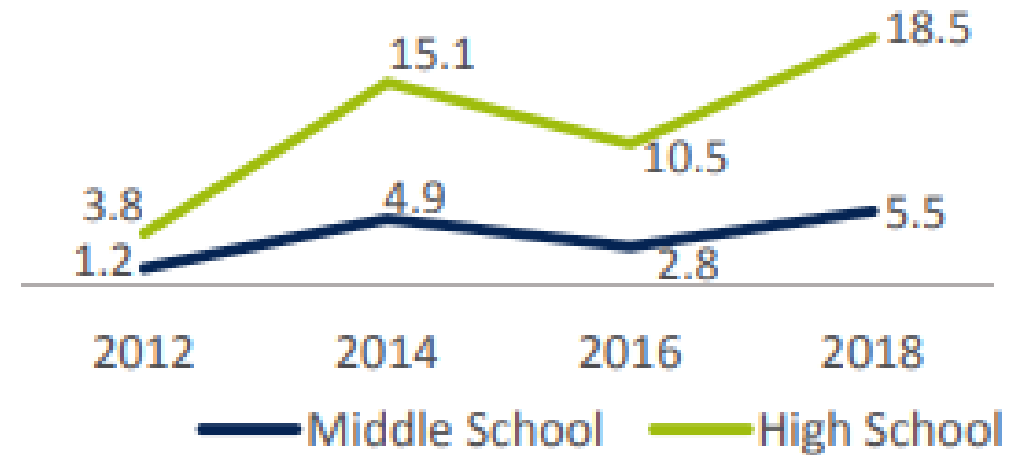
High school current use



Current Tobacco Product Use among U.S. High School Students, 2011 to 2019.

Current product use is defined as use in the past 30 days. Between 2018 and 2019, there was a change in the mode of survey administration from paper and pencil to electronic tablet. Data are from the National Youth Tobacco Survey and were provided by the Centers for Disease Control and Prevention.

Percentage of Indiana youth who report current (past 30 day) use of e-cigarettes, 2012-2018³



E-cigarette/Vaping Associated Lung Injury (EVALI)

- In early 2019, EVALI emerged as a distinct and defined diagnostic entity.
- Acute lung injury
 - Subset life threatening
 - Constellation of symptoms, laboratory and radiographic findings
 - Often in otherwise healthy young people

Definition

Confirmed Case:

Using an e-cigarette (“vaping”) or dabbing* in 90 days prior to symptom onset

AND

Pulmonary infiltrate, such as opacities, on plain film chest radiograph or ground-glass opacities on chest CT

AND

Absence of pulmonary infection on initial work-up. Minimum criteria are:

1. A negative respiratory viral panel

AND

2. A negative influenza PCR or rapid test, if local epidemiology supports influenza testing

AND

All other clinically-indicated respiratory infectious disease testing (e.g., urine Antigen for *Streptococcus pneumoniae* and *Legionella*, sputum culture if productive cough, bronchoalveolar lavage (BAL) culture if done, blood culture, HIV-related opportunistic respiratory infections if appropriate) are negative

AND

No evidence in medical record of alternative plausible diagnoses (e.g., cardiac, rheumatologic, or neoplastic process).

Probable case: infectious causes not completely ruled out



Surge in hospitalizations

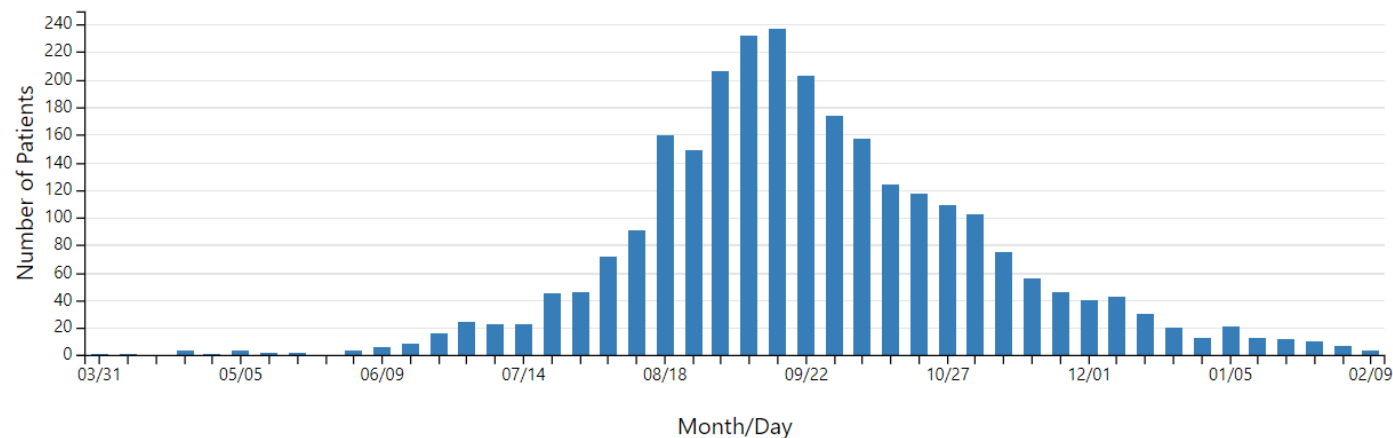
- 2807 hospitalizations/ deaths by Feb 2020

- All 50 states, D.C., PR, US VI
- 15% were <18 years old
- 68 deaths
- Outpatient cases unknown

- Number of cases peaked in Sept 2019

- Since then, there has been a steady decline of cases

Dates of symptom onset and hospital admission for patients with lung injury associated with e-cigarette use, or vaping — United States, March 31, 2019–February 15, 2020

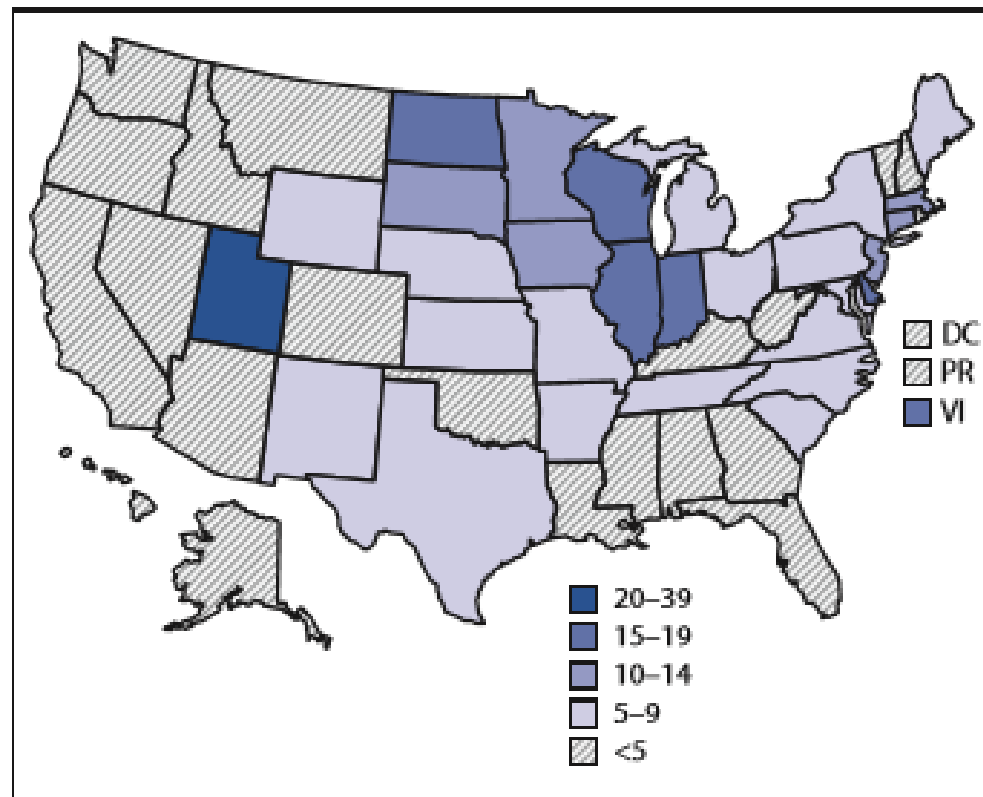


Demographics

- Hospitalized cases (adjusted for population)
- Male predominance (67%)
- White predominance (75%)

Lozier 2019

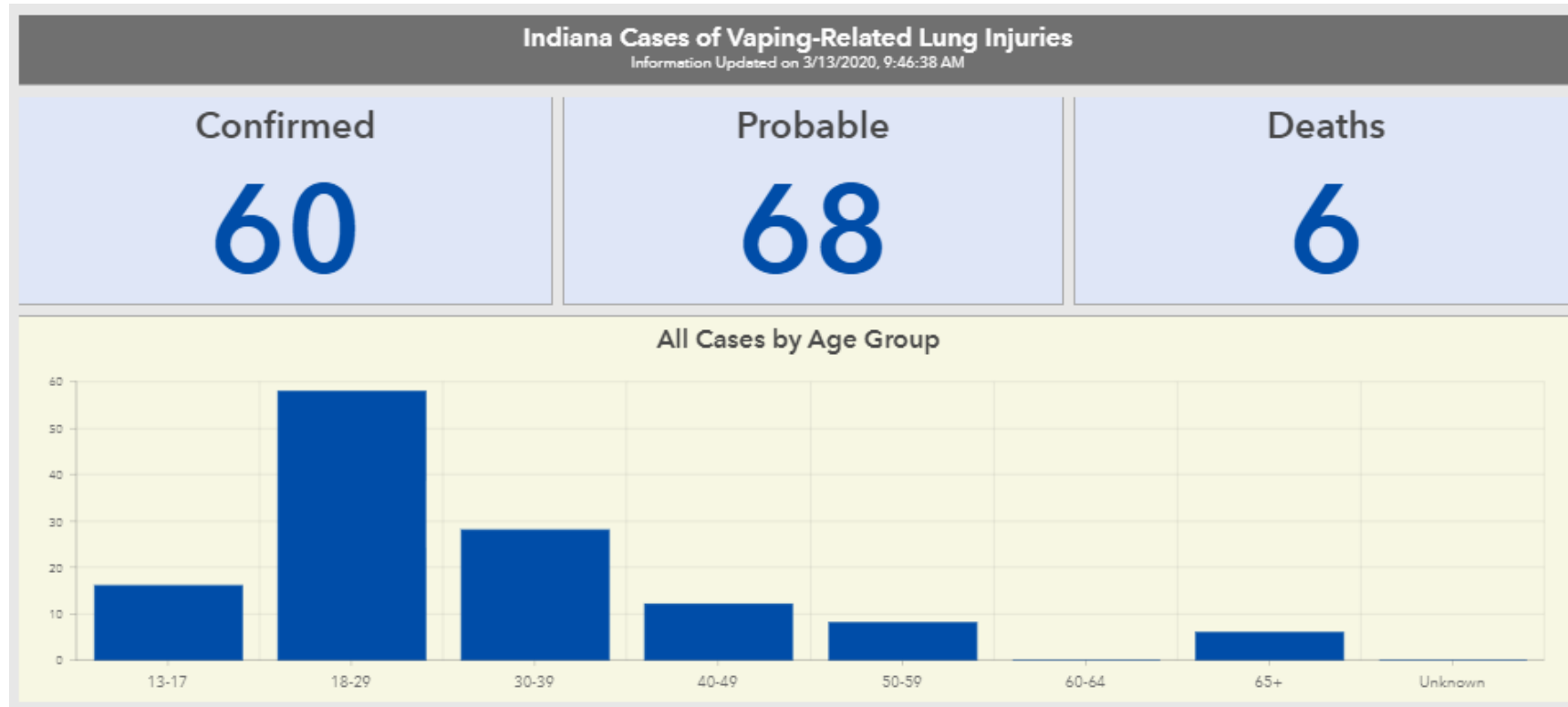
FIGURE 2. Prevalence* of hospitalized cases of e-cigarette, or vaping, product use-associated lung injury (N = 2,291) — United States, August–December 2019



Abbreviations: DC = District of Columbia; PR = Puerto Rico; VI = U.S. Virgin Islands.
* Number of cases per 1 million population rounded to the nearest hundredth. The U.S. Census population from 2010 was used to calculate prevalence for U.S. Virgin Islands, and U.S. Census population estimates from 2018 were used to calculate prevalence for all other states, the District of Columbia, and territories.

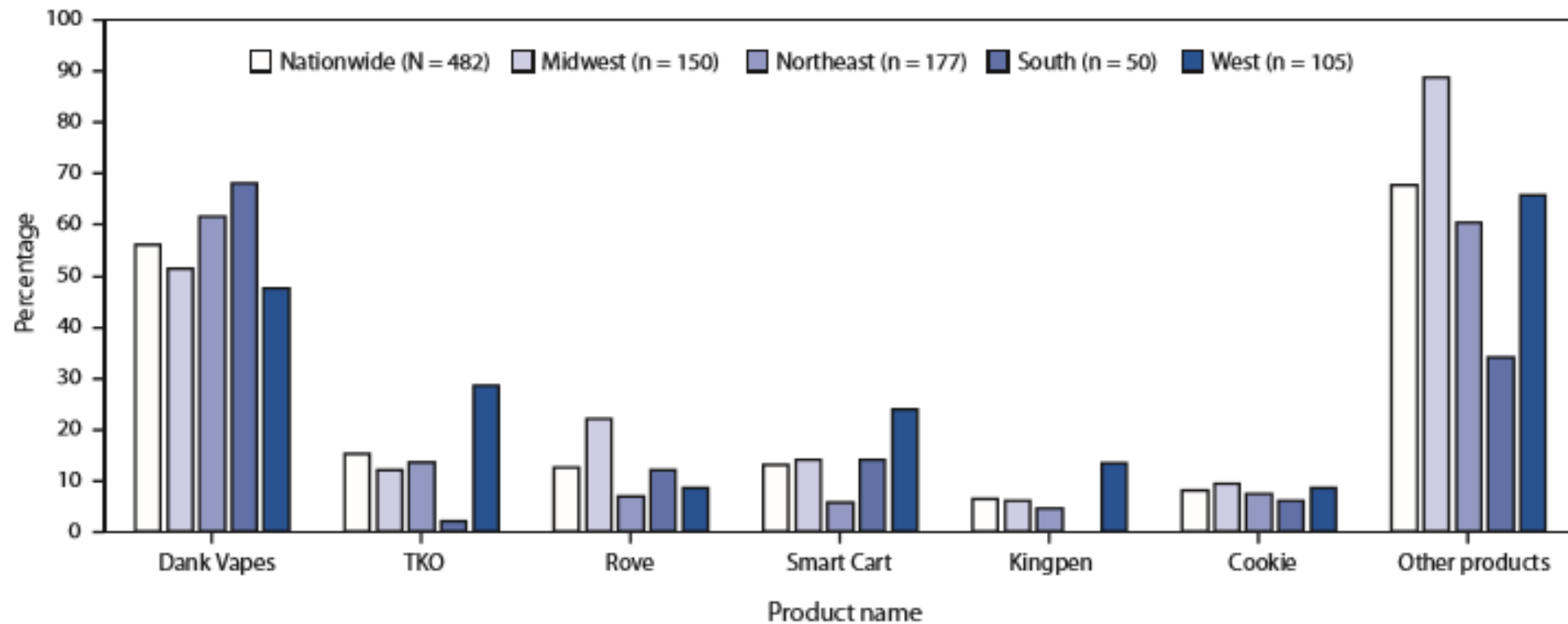
Lozier 2019

Indiana Cases



Content of Vape

FIGURE 3. Percentage of hospitalized EVALI patients (N = 482) who reported brand names of THC-containing e-cigarettes, or vaping, products,* by U.S. Census region† — United States, August–December 2019



Lozier, 2019

Vape Liquid Components (BAL)

Disrupts surfactant
(slippery substance
lining lung)



Surfactant crystallizes



Lungs stiffen



Shortness of breath,
low oxygen

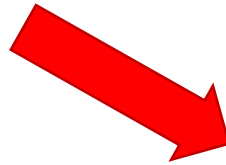


Table 3. Frequency of Detection of Priority Toxicants in EVALI Case Patients and in Healthy Comparators.*

Toxicant	EVALI Case Patients (N = 51)	Healthy Comparators			
		Nonusers (N = 52)	E-Cigarette Users (N = 18)	Cigarette Smokers (N = 29)	All Comparators (N = 99)
<i>number/total number (percent)</i>					
Vitamin E acetate	48/51 (94)	0/52	0/18	0/29	0/99
Medium-chain tri- glyceride oil	0/49	0/34	0/11	0/18	0/63
Coconut oil	1/48 (2)	0/34	0/11	0/18	0/63
Plant oil	0/49	0/34	0/11	0/17	0/62
Squalane	0/38	0/52	0/17	0/29	0/98
Squalene	0/38	0/52	0/17	0/29	0/98
α -Pinene	0/39	0/52	0/17	0/28	0/97
β -Pinene	0/39	0/52	0/17	0/28	0/97
3-Carene	0/39	0/52	0/17	0/28	0/97
Limonene	1/39 (3)	0/52	0/17	0/28	0/97
Petroleum distillates	0/12	0/52	0/17	0/29	0/98

* The listed toxicants were detected in bronchoalveolar-lavage fluid obtained from 51 patients with EVALI in 16 states from August through December 2019 and in 99 healthy comparators.

Symptoms

- Respiratory
 - Dyspnea
 - Can be very rapid in onset
 - Cough
 - Typically not productive
 - Cases of hemoptysis reported
 - Hypoxemia
- Constitutional
 - Fever (+/-)
 - Fatigue
- Gastrointestinal
 - Nausea
 - Abdominal pain

Clinical Presentation

- Wide ranging:
 - Onset (days - years of usage)
 - Acuity
 - Severity








- One study: 45% had been seen in outpatient setting prior to hospitalization, treated with antibiotics for presumed infection

Diagnosis

History (recent and former use)

Type and content

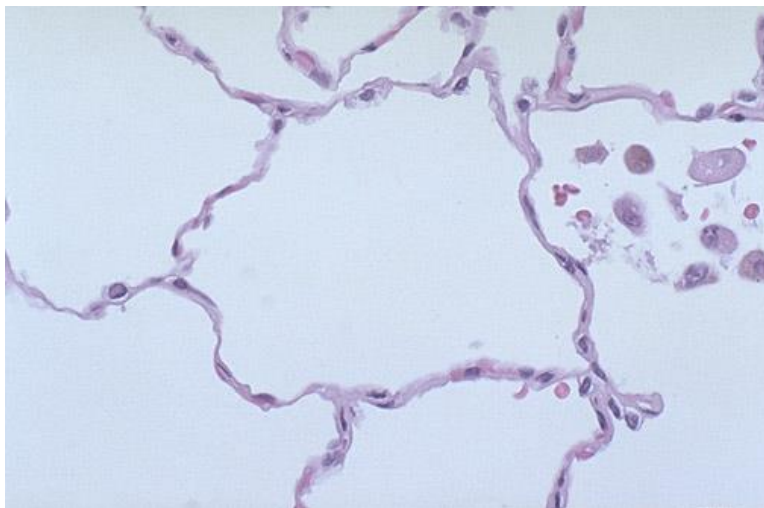
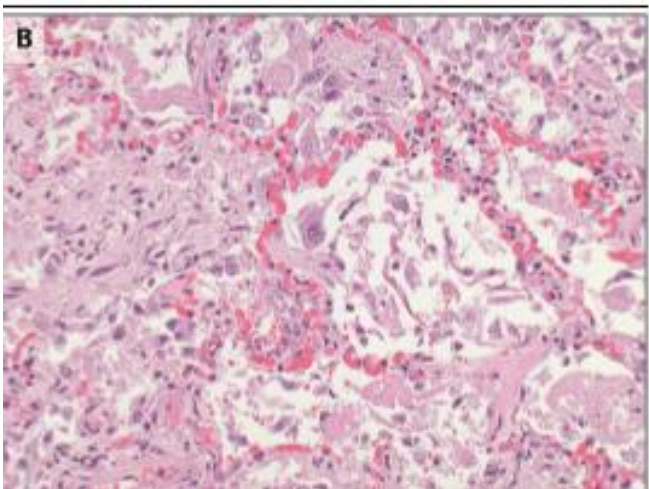
Recommended:

- White blood cell counts  
 - Neutrophils
 - Eosinophils
- Inflammatory markers (CRP, ESR) 
- Urine toxicology
- Liver function  
- Viral testing
(COVID)
- CXR

Consider:

- Histoplasma
- TB
- Legionella
- Sputum culture
- HIV/Opportunistic
 - Depending on presentation
- Noncontrast chest CT

Microscopic Findings



- Diffuse lung damage
- Inflammation of airways and alveolar spaces
 - Mixed inflammatory process
- Filling of air spaces with sloughed epithelial cells

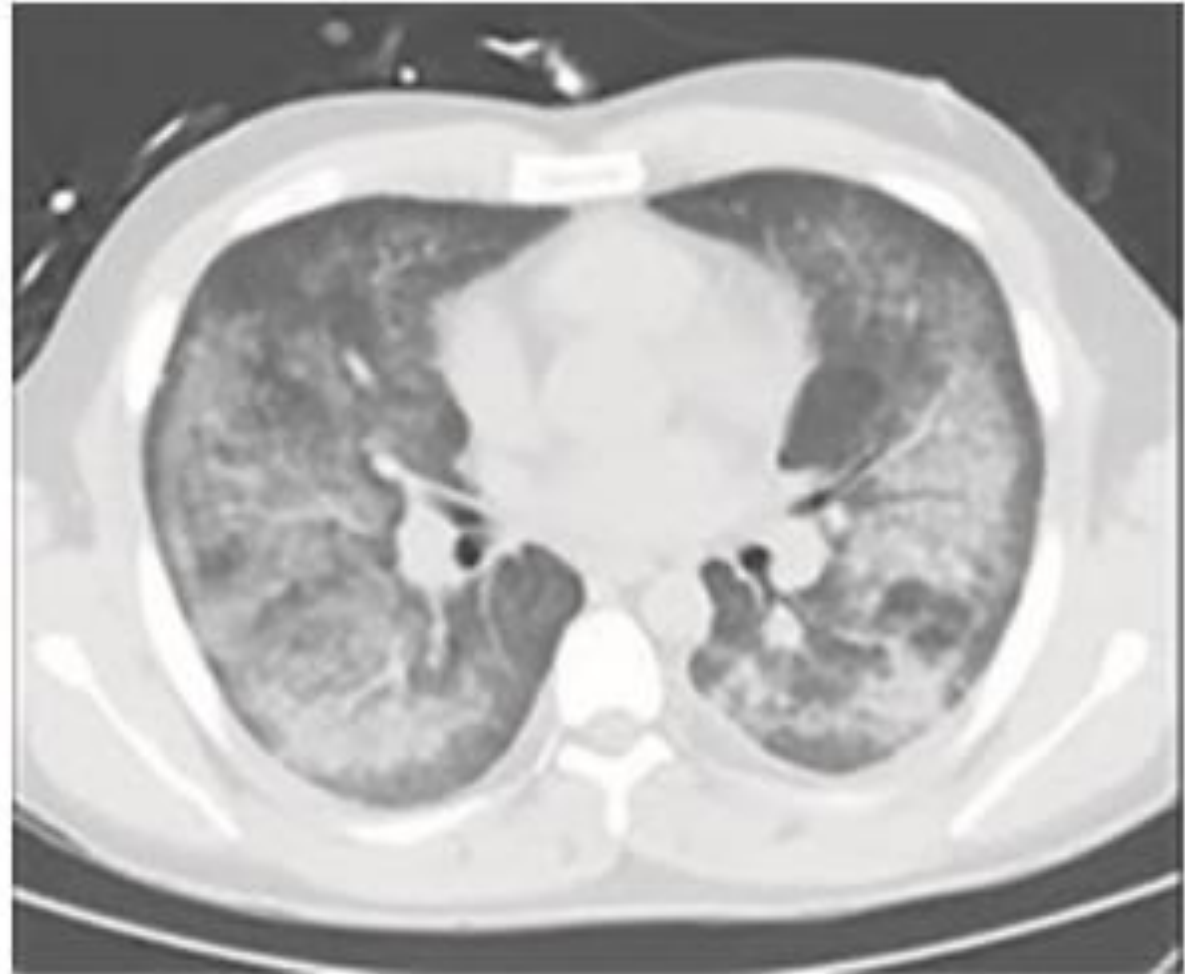
Radiology Findings

Most common

- Ground glass opacities
- Often subpleural sparing

Other findings:

- Pulmonary hemorrhage
- Pleural effusions
- Interstitial pneumonitis



Hilton, 2020

Treatment

- Antibiotics considered if signs of acute infection
 - At least until diagnosis confirmed
- Steroids
 - IV or oral
 - Dose, duration and timing depend on severity, possibility of infection
- Cessation
 - ?nicotine withdrawal
 - Consider child psychiatry if dependence suspected

Pediatrics 2020, 146 (1) e20194104; DOI: <https://doi.org/10.1542/peds.2019-4104>

Mortality

2407 cases by December 2019

- 52 (2%) fatal
- Risk of readmission
 - 2.7% readmitted (median 4 days)
 - 7 deaths (of 2407 hospitalizations) AFTER discharge
 - Median 3 days
 - Older users (median age 53y), ↑comorbidities

MMWR 2020. 68; 1183-1188.

Outpatient follow-up evaluation

Within days of discharge:

- Confirm respiratory status is stable, improving
 - Reinforce importance of abstinence from e-cigarette, or vaping, product use
 - Assist w/ coordination of care as indicated (e.g. mental health, substance abuse, PT)
- Advise to return ASAP if develop new or worsening respiratory symptoms

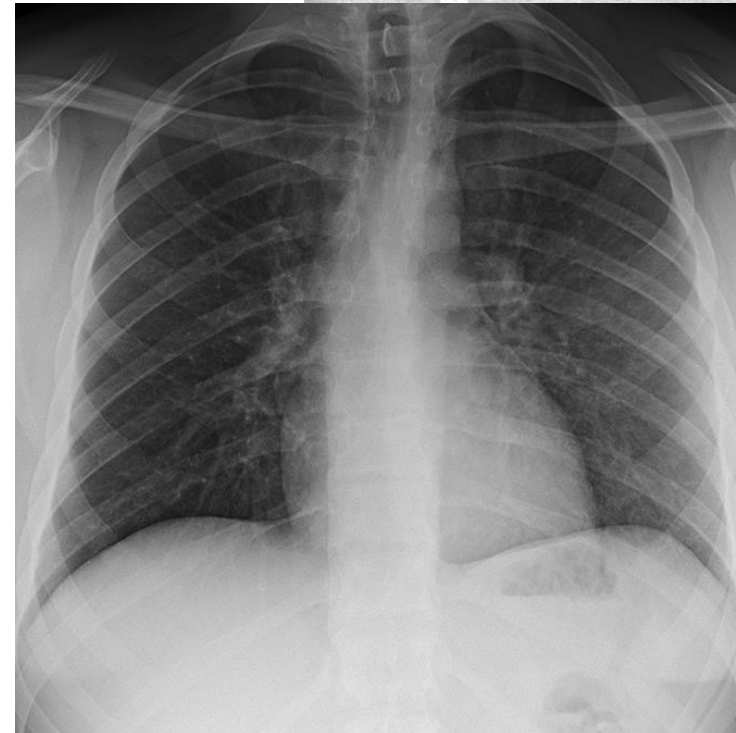
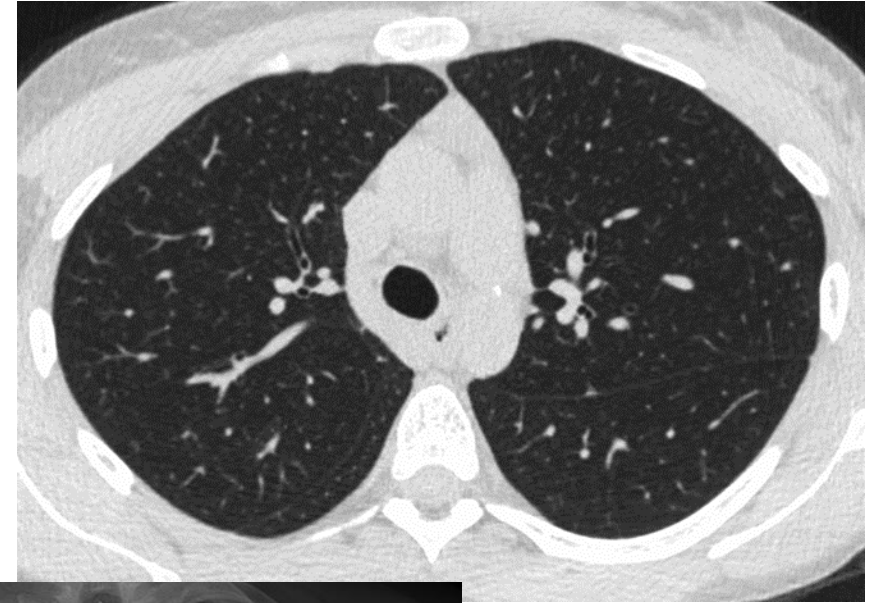
Some fatalities reported days after discharge

Weeks to months after discharge

- Assess pulmonary function, repeat chest Xray or CT
- Continue to educate & counsel

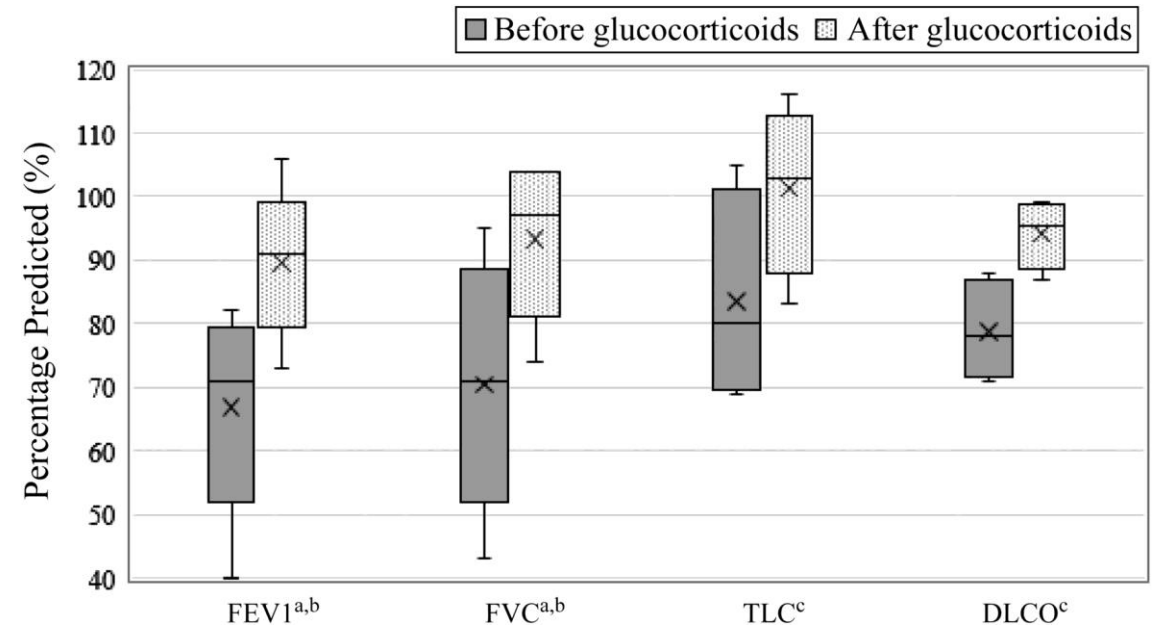
Outcomes - Symptoms

- Most make complete or near complete recovery
- Radiographic resolution
- Time frame:
 - Days to weeks after discharge
 - Some with longer time courses, remain symptomatic at 6-8 weeks
- Some needed home oxygen with activity after discharge
 - 31% in one study
 - Varies by center, length of hospitalization



Outcomes – Lung Function

- Lung function often abnormal
- Improves with steroids DLCO abnormalities
- Can make full recovery with time, treatment



Review

- Suspicion of vaping product use
- Symptoms: cough, shortness of breath, chest pain, GI, fever
- Diagnosis of exclusion
 - Infection, other exposures should be considered
- Treatment: steroids, supportive care, time, cessation, possibly oxygen
- Recovery is possible
 - Potential for longterm pulmonary complications
 - Pulmonary followup and testing typically needed

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