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Gebruik de QR-code of link in de chat aan het eind van de scholing.
- Toets kan worden ingevuld tot morgen 12 uur



Vapen & longfibrose

Ömer Balak, longarts



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Programma KKO

Tijd	Onderwerp	Spreker
17.15 uur	Introductie onderwerp. Eventueel nieuwe artsen in regio kort voorstellen.	Voorzitter: Sabrina Heijkoop, huisarts Zwijndrecht
17.25 uur	Vapen & longfibrose	Omer Balak, longarts Albert Schweitzer ziekenhuis
18:00 uur	Vragen stellen & discussie	
18.15 uur	Afsluiten	Sabrina Heijkoop, huisarts

Disclosure belangen

Sabrina Heijkoop, huisarts
Kort Klinisch Onderwijs (KKO), Albert Schweitzer ziekenhuis,
11 maart 2025

(potentiële) belangenverstrengeling	Geen
Voor bijeenkomst mogelijk relevante relaties met bedrijven	Geen
• Sponsoring of onderzoeksgeld • Honorarium of andere (financiële) vergoeding • Aandeelhouder • Andere relatie, namelijk ...	Geen Geen Geen Geen

Inleiding Sabrina

Disclosure belangen

Ömer Balak, longarts

Kort Klinisch Onderwijs (KKO), Albert Schweitzer ziekenhuis,

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Vapen & longfibrose

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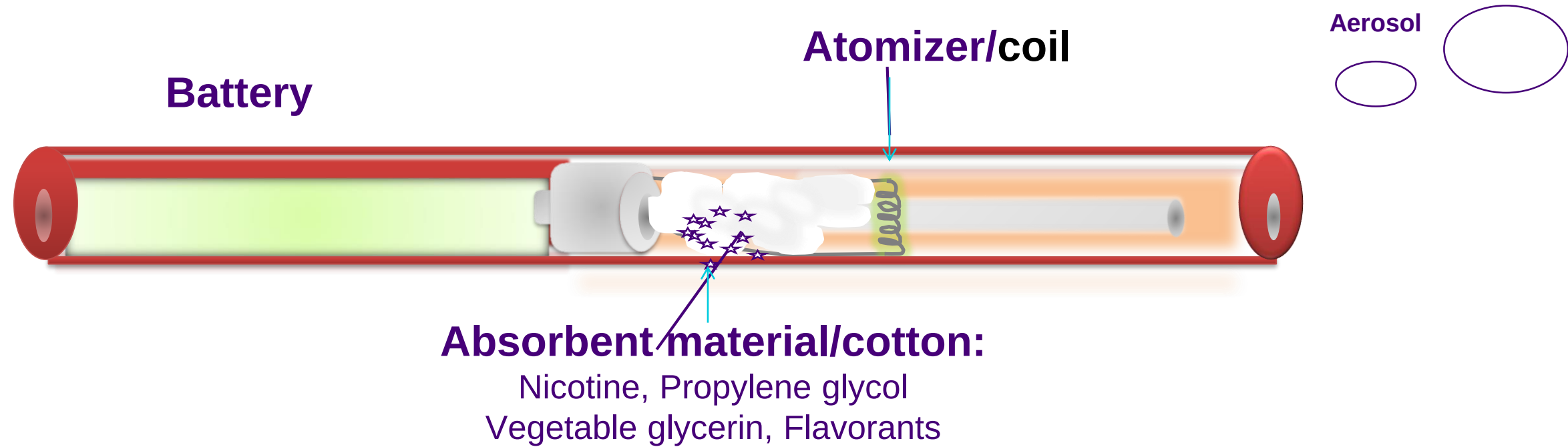
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Wat is e-sigaret

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Batterij

De batterij levert de energie om de gloeidraad te verhitten.

Vloeistof

De vloeistof bevat nicotine, propylene glycol, plantaardige glycerin, smaakstoffen

Gloeidraad

De gloeidraad verhit de vloeistof en creëert damp.

Absorberend materiaal

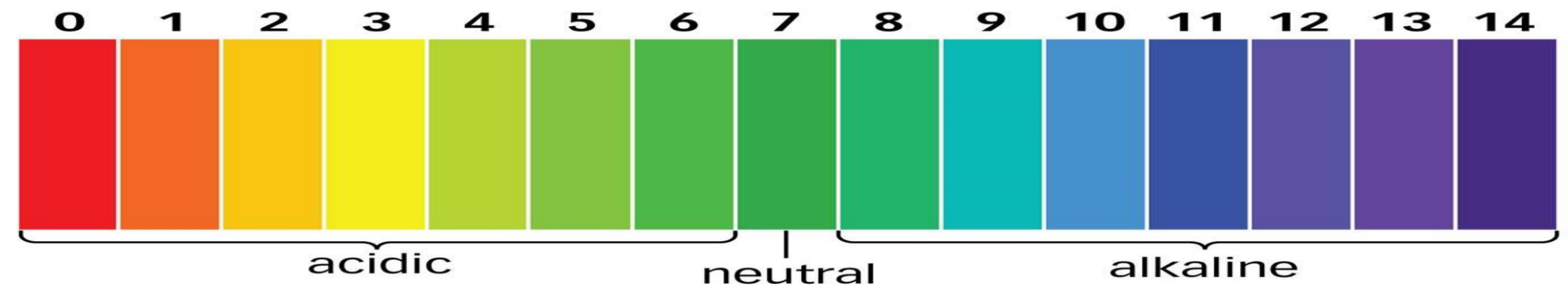
Katoen absorbeert de vloeistof en zorgt voor een soepele damp.

Evolution of the e-cigarette



Nicotine Comes In Different Types

pH
Scale



Concentratie

De concentratie van stoffen in de damp varieert per e-sigaret en vloeistof.

Voltage

Hoger voltage leidt tot meer schadelijke stoffen in de damp.

Risico's van e-sigaretten

1

Nicotineverslaving

E-sigaretten bevatten nicotine, wat verslavend is.

2

Gezondheidsrisico's

De damp bevat schadelijke stoffen die kunnen leiden tot ademhalingsproblemen, hart- en vaatziekten en kanker.

Oxidatieve stress

Schadelijke stoffen veroorzaken oxidatieve stress, ontsteking en celdood.

3

Onveiligheid

E-sigaretten kunnen exploderen of brand veroorzaken.



De rol van de tabakindustrie

Sluwe strategie

De tabaksindustrie promoot e-sigaretten om nieuwe klanten te werven.

Verslaving

Jongeren raken verslaafd aan nicotine via e-sigaretten.

Levenslange klanten

Verslaafde jongeren worden levenslange klanten voor de tabaksindustrie.

YOUNG PEOPLE YOUR AGE

90% of adult smokers started before 18



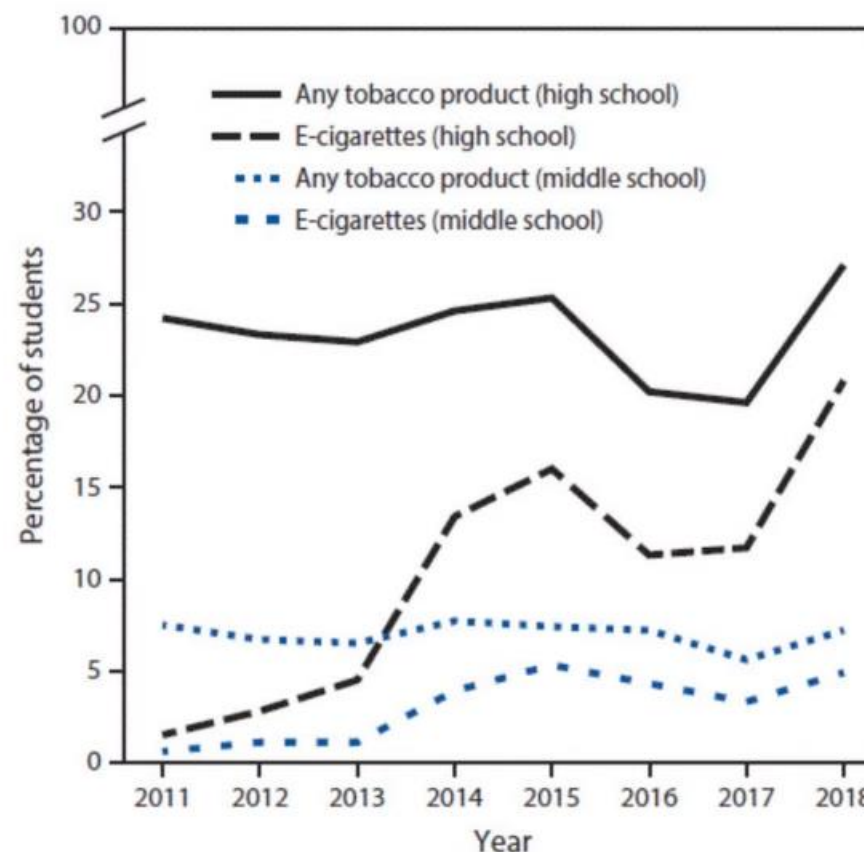
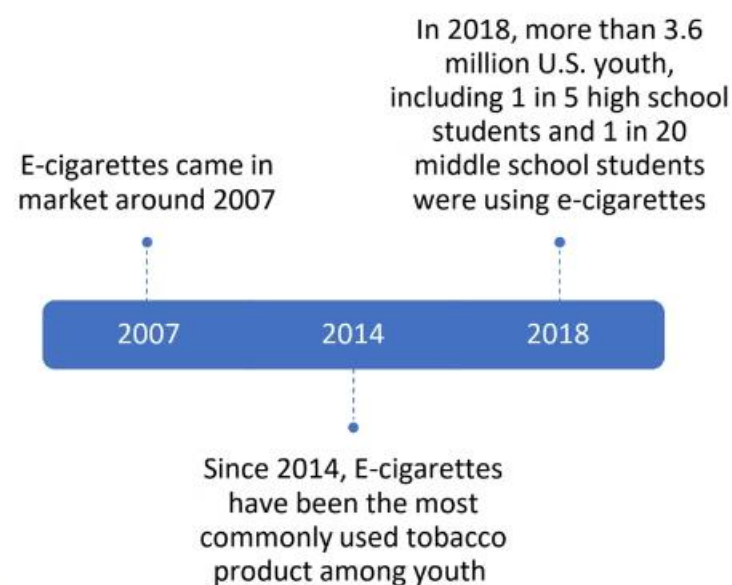


E-sigaretten: een verraderlijk begin

- 1 E-sigaretten worden vaak gepromoot als een veiliger alternatief voor roken, maar is dat wel zo?
- 2 Een op de drie jongeren die een e-sigaret probeert, raakt verslaafd aan roken.
- 3 Jongeren die maandelijks vaperen, roken vaak ook sigaretten.

De verleiding van de vape

Magnitude of problem among youth



National Youth Tobacco Survey, United States, 2011–2018
Cullen KA et al MMWR 2018

Smaakjes

Vapes zijn verkrijgbaar in veel verschillende smaken, zoals fruit, snoep en drank.

Reclame

Vaak gepromoot door influencers en celebrities, die een coole en onschuldige indruk geven.

De verborgen gevaren van nicotine

Verborgen in de damp

De vloeistof bevat geen tabak, maar wel nicotine, soms in een hoeveelheid gelijk aan 4 pakjes sigaretten.

Gevaarlijk voor kinderen

Een kind dat een vape in één keer oprookt, kan een nicotinevergiftiging krijgen. (misselijkheid, braken, hoofdpijn en in ernstige gevallen zelfs een epileptische aanval)

Wat zit er in een vape?

Nicotine

De meest bekende stof in vape-vloeistof. Nicotine is verslavend en kan leiden tot pulmonale en cardiale problemen.

Glycerol

Een zoetstof die de vape-vloeistof een gladde textuur geeft. Glycerol is niet schadelijk, maar kan bij hoge temperaturen gevaarlijk zijn.

Propyleenglycol

Een vloeistof die de vape-vloeistof dunner maakt en helpt de nicotine te transporteren. Propyleenglycol kan irritatie aan de longen veroorzaken.

Smaakstoffen

Smaakstoffen worden toegevoegd om de vape-vloeistof lekker te maken. Sommige smaakstoffen kunnen irriterend zijn voor de luchtwegen.

Cigs in a Pod



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1 Pack of Cigarettes
≈ 20 mg of nicotine

1 JUUL pod
≈ 41.3 mg of nicotine

1 Puff bar
≈ 50 mg of nicotine

1 Suorin pod
≈ 90 mg of nicotine

ALL PODS CONTAIN HIGH
LEVELS OF NICOTINE

≈ 20
CIGARETTES

≈ 41
CIGARETTES

≈ 50
CIGARETTES

≈ 90
CIGARETTES



Aerosols³³⁻³⁷

Listed ingredients

Glycerol

Propylene glycol

Nicotine

Other compounds detected

Acetaldehyde

Acetone

Acrolein

Formaldehyde

N'-nitrosonornicotine (NNN)

4-(Methylnitrosamino)-1-(3

Metals (cadmium, lead, ni

Toluene

myosmine, and
d in some products,
ed as an ingredient)

Veel meer dan alleen nicotine

Naast nicotine bevat vape-damp een lange lijst met andere chemicaliën.

Gevaarlijke stoffen

Sommige van deze chemicaliën zijn schadelijk voor de gezondheid.

Onbekend

De langetermijneffecten van sommige stoffen zijn nog onbekend.

Which Chemicals Are Found in E-Cig/Pod-Based Aerosol?

• Propylene glycol • Glycerin • Flavorings (many) • Nicotine • NNN • NNK • NAB • NAT • Ethylbenzene • Benzene • Xylene • Toluene • Acetaldehyde • Formaldehyde • Naphthalene • Styrene • Benzo(b)fluoranthene	• Chlorobenzene • Crotonaldehyde • Propionaldehyde • Benzaldehyde • Valeric acid • Hexanal • Fluorine	• Benzo(ghi)perylene • Acetone • Acrolein • Silver • Nickel • Tin • Sodium	• Cadmium • Silicon • Lithium • Lead • Magnesium • Manganese • Potassium • Titanium • Zinc • Zirconium • Calcium • Iron • Sulfur • Vanadium • Cobalt • Rubidium
All of these have been found in e-cigarette/pod-based aerosol			
• Fluoranthene • Benz(a)anthracene • Chrysene • Retene • Benzo(a)pyrene • Indeno(1,2,3-cd)pyrene		• Boron • Copper • Selenium • Arsenic • Nitrosamines • Polycyclic aromatic hydrocarbons	
Compounds in orange are from FDA 2012, Harmful and Potentially Harmful Substances – Established List			

What's in that Pod?

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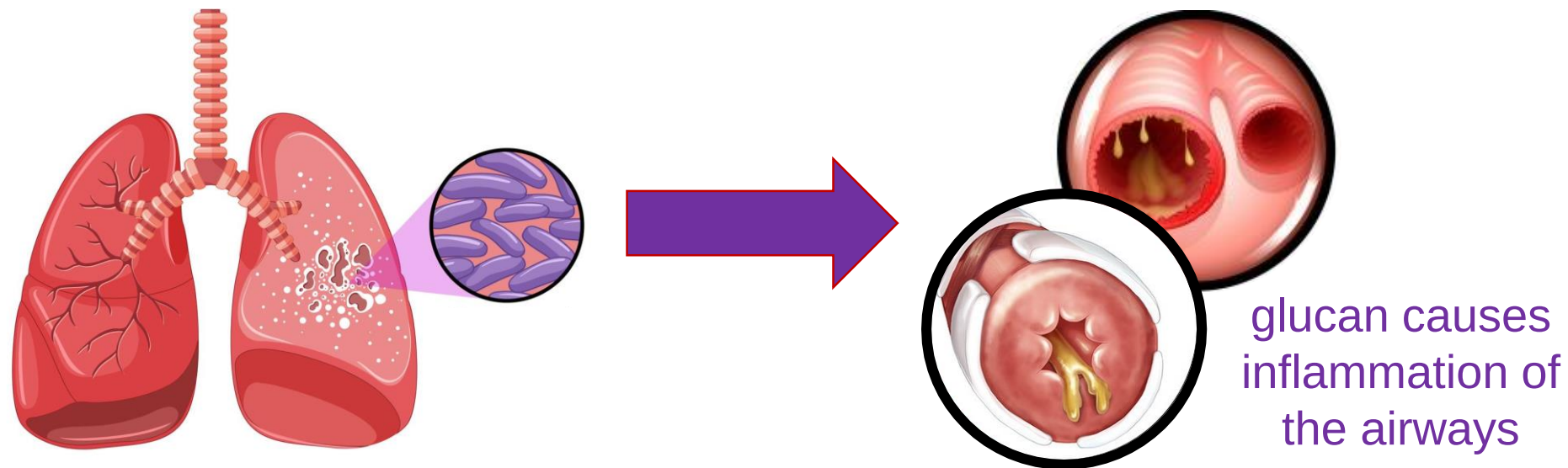
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Glucan, a microbial toxin, found in Juul's nicotine vaping liquids



January 2, 2020 – E-cigarette products made by Juul Labs were contaminated with a microbial toxin that can cause long-term lung damage according to an analysis conducted by researchers from Harvard T.H. Chan School of Public Health.

The study, published online December 9, 2019 in the American Journal of Respiratory and Critical Care Medicine, was co-authored by David Christiani, Elkan



Wat zit er echt in een pod?

200+

Chemicaliën

Meer dan 200 chemicaliën kunnen aanwezig zijn.

30

Gevaarlijk

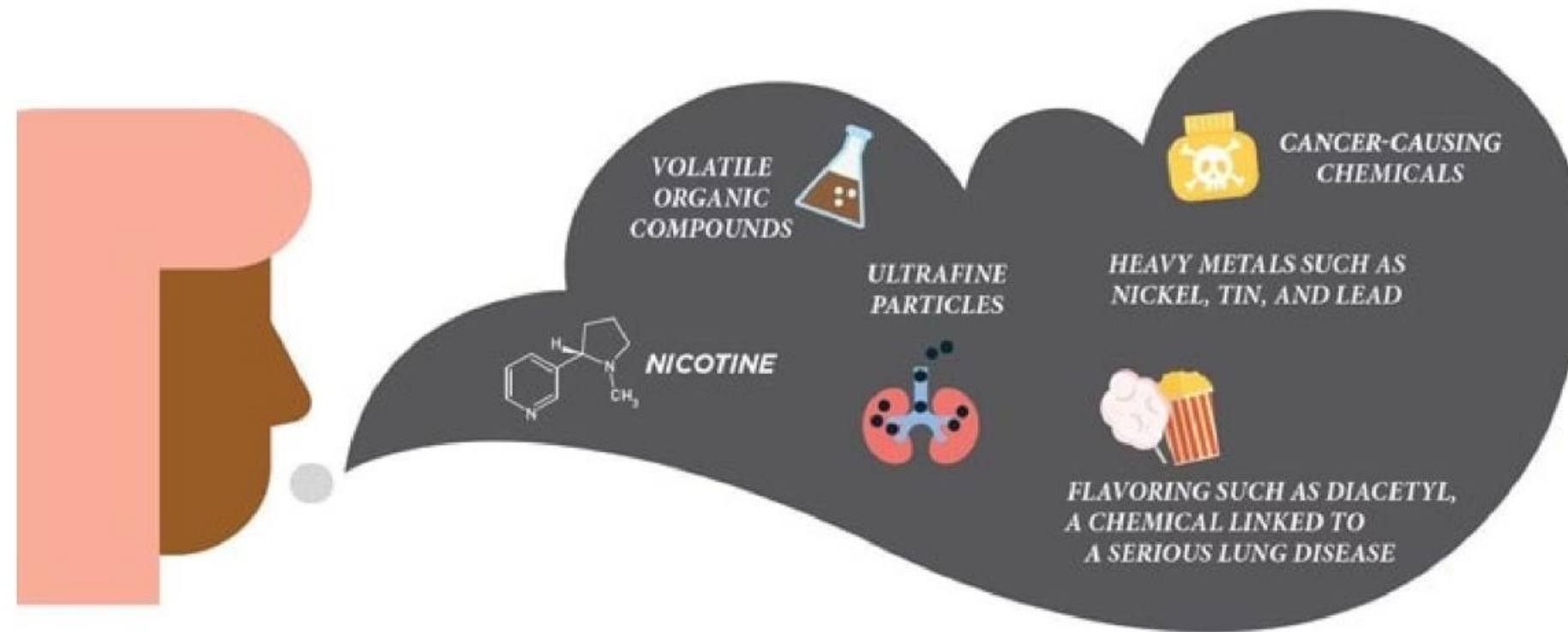
30 daarvan zijn op de lijst van de FDA met schadelijke stoffen.

100

Onbekend

De effecten van 100 stoffen zijn nog onbekend.







Kankerverwekkende Stoffen

Kanker

Vapes bevatten kankerverwekkende stoffen zoals nitrosamine derivaten, aromatische amines, formaldehyde en benzeen.

DNA Schade

Deze stoffen veroorzaken DNA schade, de basis van kanker.

DNA Schade Vergelijkbaar



Onderzoek

Een Amerikaans onderzoek met mondslijmvlies monsters toont aan dat vapen dezelfde DNA schade veroorzaakt als roken.

Langetermijn Gevolgen



De langetermijn effecten van vaperen op de gezondheid zijn nog niet volledig bekend, maar de risico's lijken tegelijk met de risico's van roken te zijn.

De invloed op de hersenen

1

Cognitieve problemen

Nicotine kan problemen veroorzaken met concentratie, aandacht en geheugen.

2

Stemmingswisselingen

Nicotine kan leiden tot stemmingswisselingen en angstgevoelens.

3

Verslaving

Het kan de kans op verslaving op latere leeftijd verhogen.

Nicotine by Nicotine:
highlighting all areas affected and nicotine affected by with signal and motor



TABLE 1. Health-Related Effects of Electronic Cigarettes

Pulmonary effects

Heat- and solvent-related carcinogenic compounds
Respiratory epithelial injury
Reduced mucociliary clearance
Increased risk of respiratory tract infections
Vaping-related acute lung injury (see [Table 3](#))
Increased airway reactivity

Cardiovascular effects

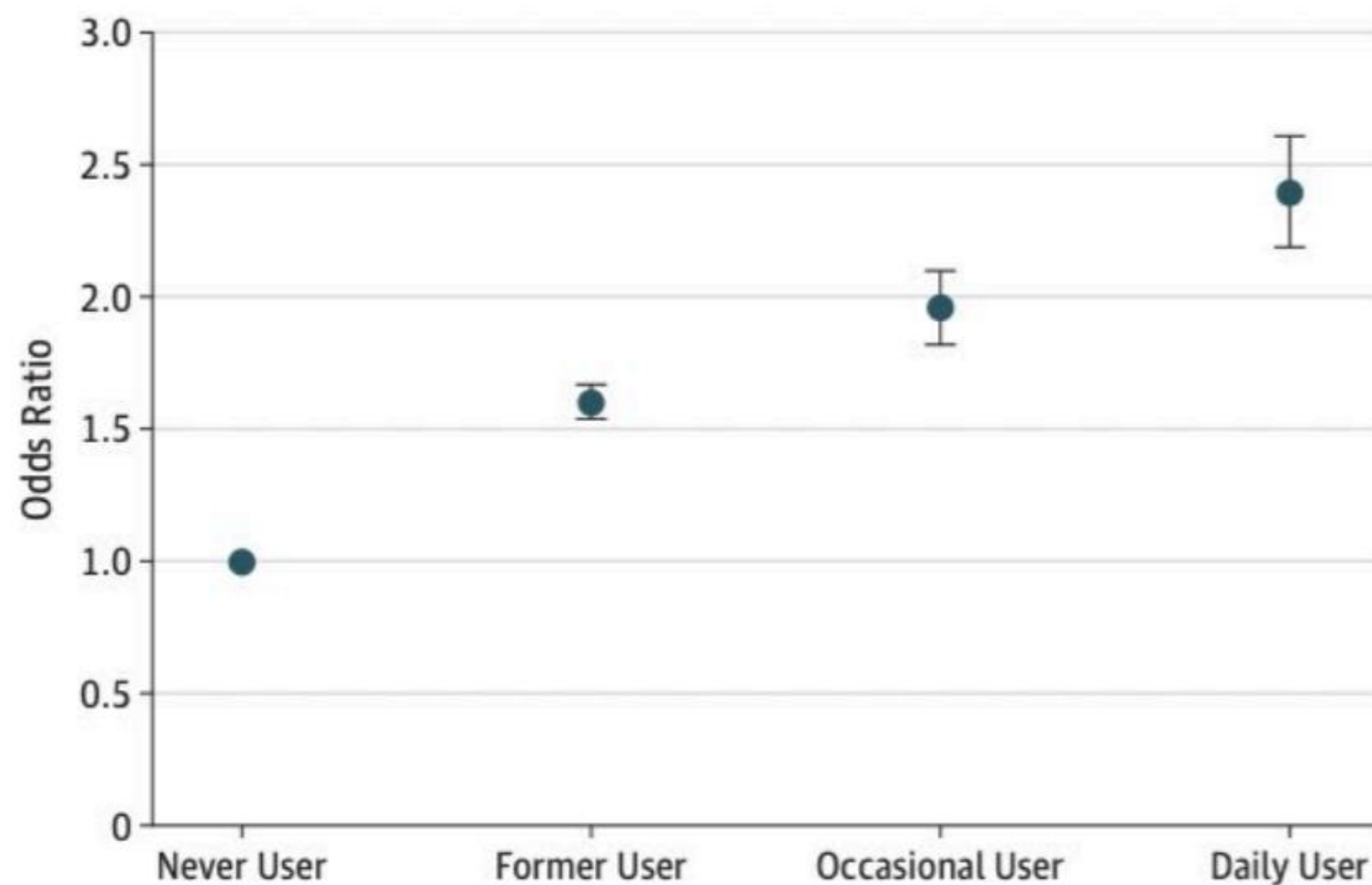
Increased oxidative stress and inflammation
Increased platelet aggregation
Increased odds of myocardial infarction

Thermal injury

Psychosocial effects

Nicotine addiction
Increased cannabis tolerance and withdrawal
Increased use of other tobacco products, alcohol,
and illicit drugs

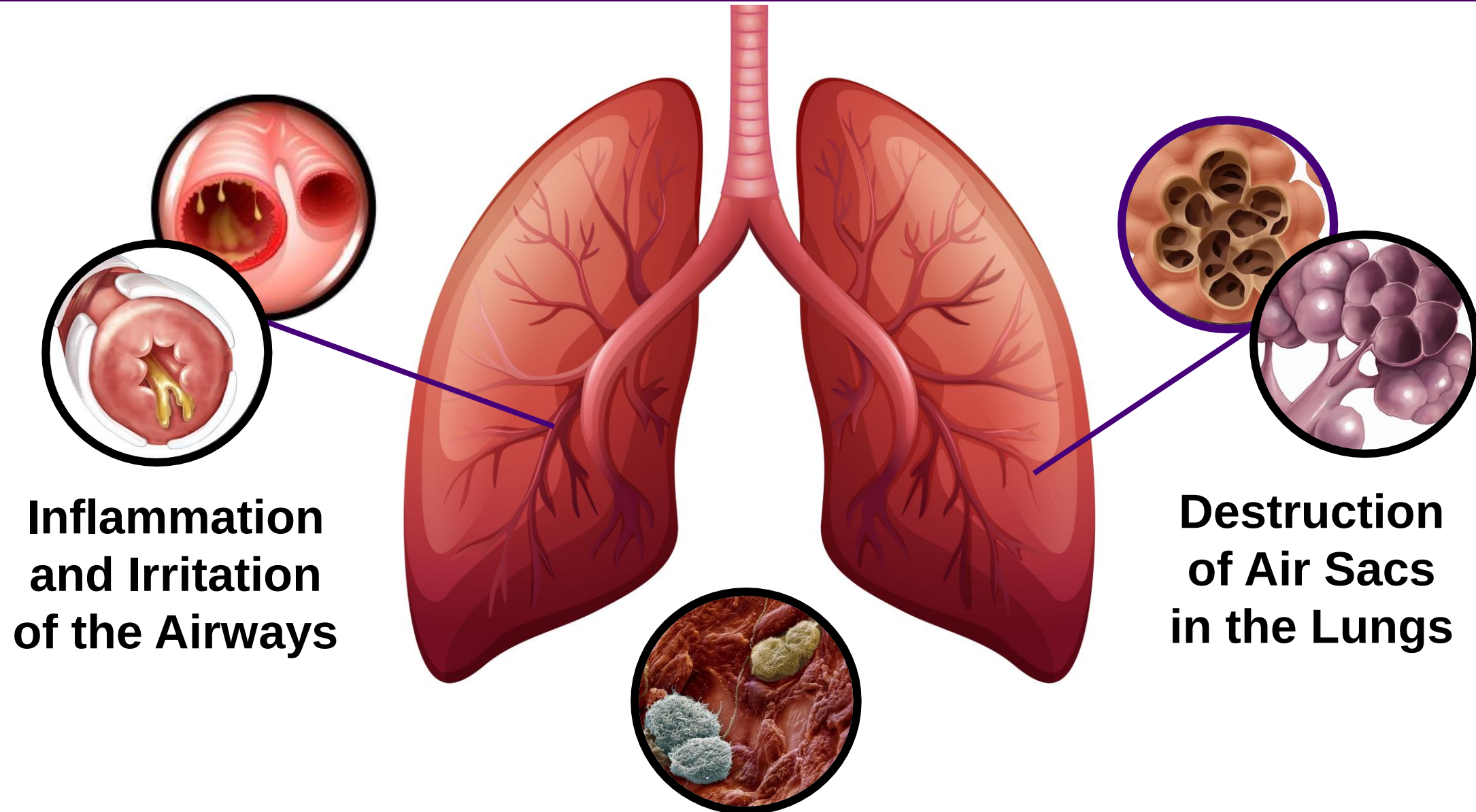
Figure 1. Association Between Electronic Cigarette Use and History of Clinical Diagnosis of Depression



No Fun in the Lungs

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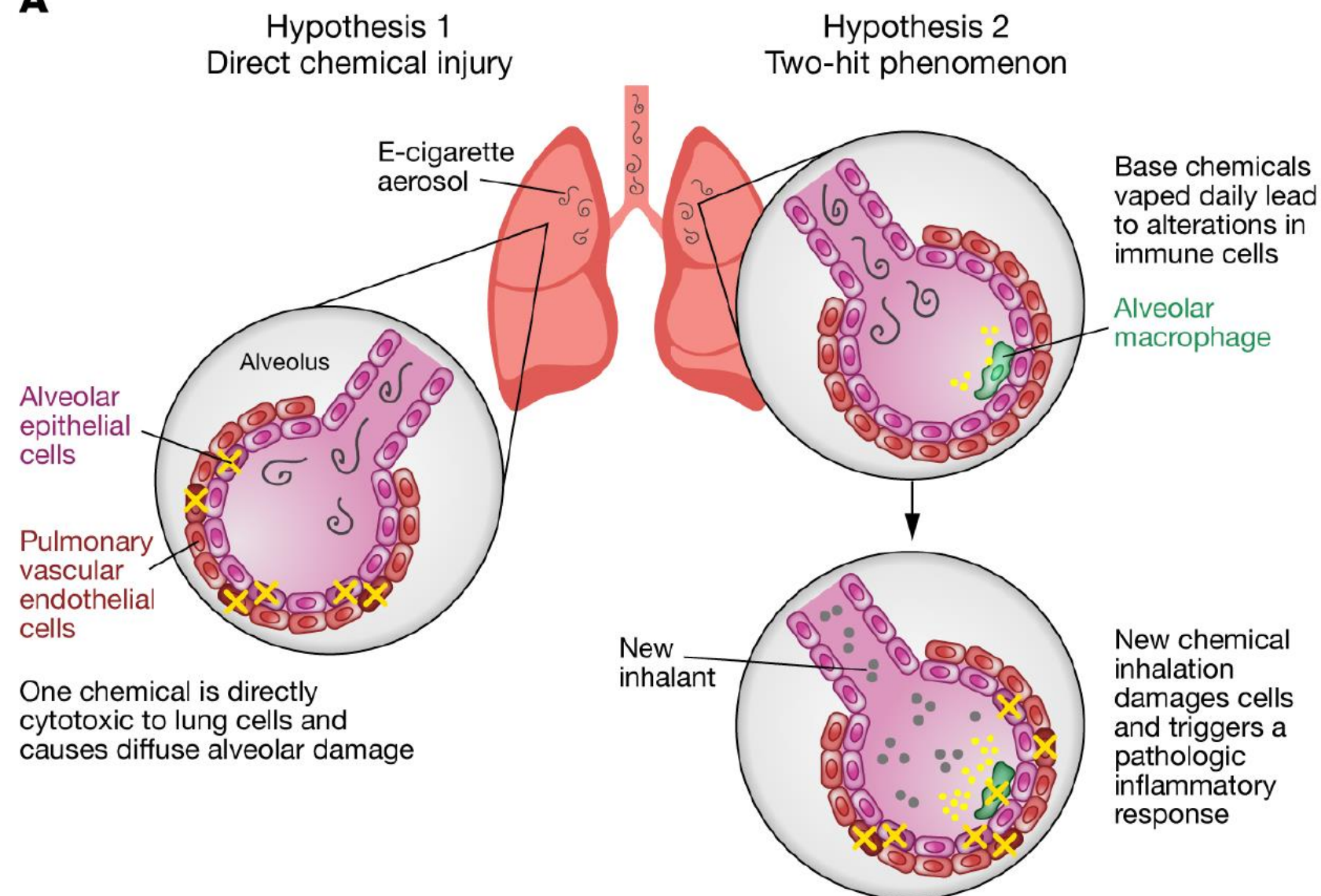


**Inflammation
and Irritation
of the Airways**

**Destruction
of Air Sacs
in the Lungs**

Weaker Immune Response to Infection

A



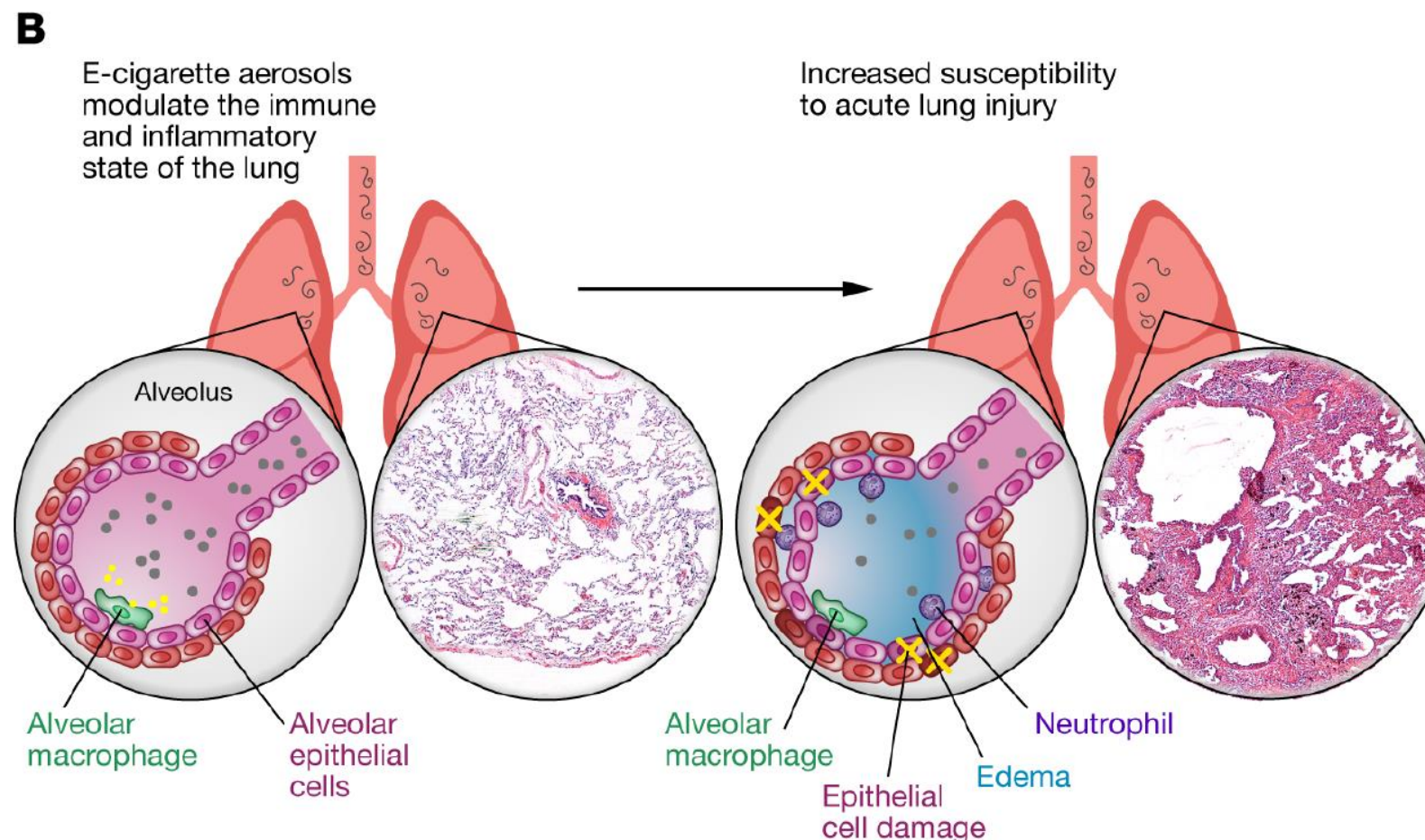


Figure 1. Mechanisms underlying lung injury in EVALI. (A) In the panel on the left, cells of the lung are damaged by one chemical inhaled within e-cigarette aerosols. This cell damage leads to epithelial and endothelial cell necrosis (indicated by a yellow “X”). An alternative hypothesis is depicted on the right, in which inhalation of chemicals common in e-cigarette aerosols (propylene glycol, glycerin, nicotine, or THC) alters the inflammatory state of the lungs, including changing alveolar macrophages to a proinflammatory phenotype with the release of inflammatory cytokines (indicated by yellow circles), such that a second hit causes a pathologic inflammatory response. (B) The immune state of the lungs is known to be altered by the chronic, daily inhalation of e-cigarette aerosols. It is likely that vitamin E is directly cytotoxic to lung cells (indicated by a yellow “X”), leading to necrosis, neutrophil recruitment and activation resulting in collateral damage, and noncardiac pulmonary edema. Illustration credit: Rachel Davidowitz. H&E-stained lung tissues are from the UCSD Liebow Collection, 1974.

Pulmonary Effects -Animal Data

- **Associated with increased inflammation**
 - **Increased cytokines**
 - **Increased capillary leak**
 - **Endothelial Dysfunction**
- **Increase in airway hyperreactivity**

EVALI (E-cigarette Vaping Associated Lung Injury)

1

Oorzaak

EVALI is waarschijnlijk veroorzaakt door vitamine E-acetaat.

2

Verboden

Vitamine E-acetaat is verboden in e-vloeistoffen in Nederland.

3

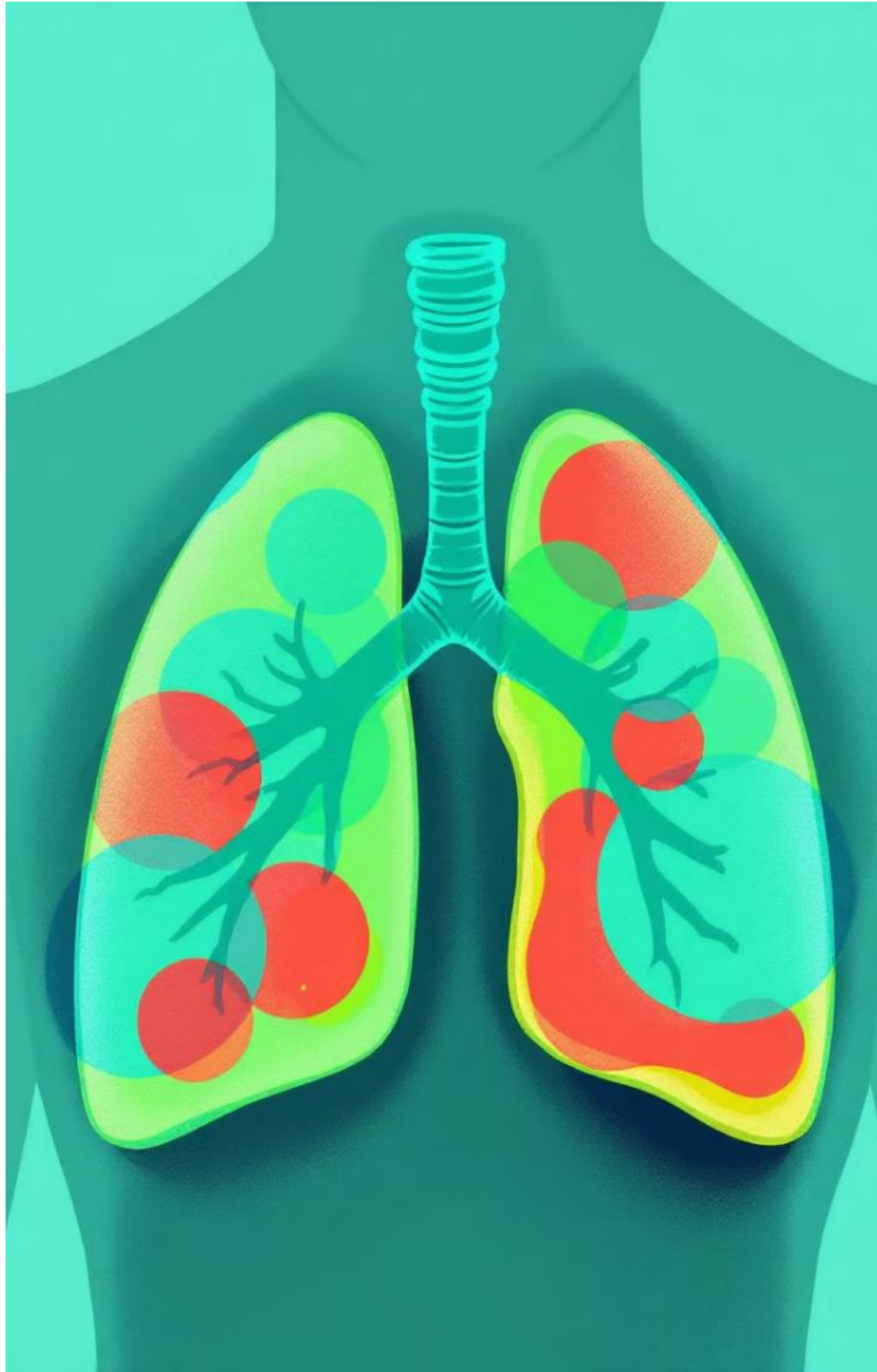
Onbekend

Het is onbekend of andere stoffen een rol spelen bij EVALI.

4

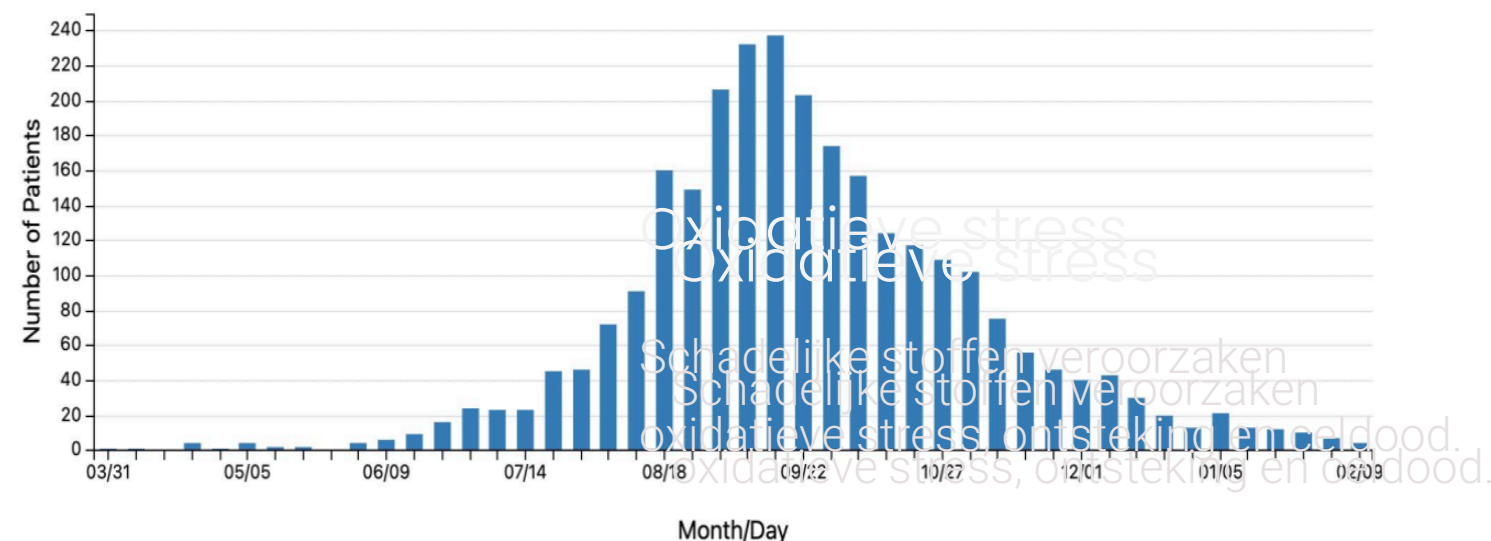
Verdwenen

EVALI lijkt na een hoogtepunt in september 2019 inmiddels verdwenen, maar de risico's blijven.



E-Cigarette Vaping Associated Lung Injury(EVALI)

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



Numbers do not sum to 2,807 due to missing admission dates.

**August 2019: Cases of EVALI-associated with
Vitamin E acetate**

Box 1: Some potential causes of pulmonary injury from vaping^{52,53,66,68}

E-liquid component	Chemical or compound
Carrier solution	• Propylene glycol • Vegetable glycerin
Flavourants	• Diacetyl • 2,3-Pentanedione • Acetoin
Additives	• Nicotine • Tetrahydrocannabinol • Cannabidiol • Butane hash oil • Other oil-rich additives
Adulterants	• Vitamin E acetate (tetrahydrocannabinol adulterant)
Aerosol emissions	• Carbonyls from heating propylene glycol and vegetable glycerin • Particulates • Trace metal elements • Volatile organic compounds
Contaminants	• Bacterial endotoxins • Fungal glucans

Patogenese en Risicofactoren

- Patogenese van EVALI is niet bekend
- Tetrahydrocannabinol
- Vitamine E acetaat
- Nicotine
- Andere, CBD olie, andere pantardige olies



Vitamin E Acetate

- **Added to THC-Containing vaping liquids**
- **Can disrupt surfactant function**
- **Can generate pulmonary irritants when heated**



Vitamin E Acetate

- Found in 48 or 51 EVALI patients on BAL fluid
- Began to appear in THC products in 2019

Other Potential Causes

- Other oils, THC, Nicotine, unidentified agent

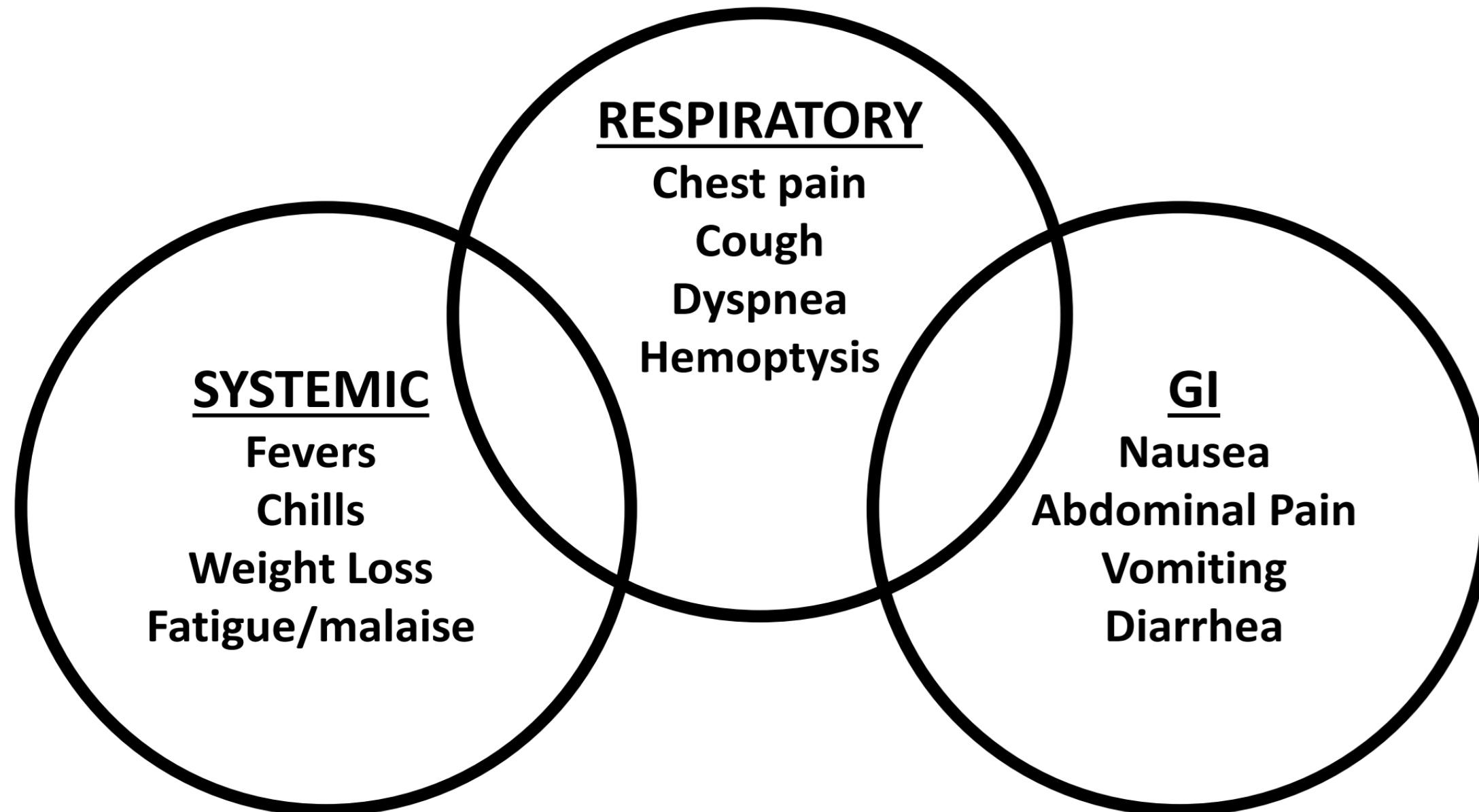
Cases

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- **As of February: 2,758 hospitalized cases**
 - **66% male**
 - **Median age 24 years (13-85 years)**
 - **15% < 18 years**
 - **37% 18 to 24 years**
 - **24% 25 to 34 years**
 - **24% 35 or older**
 - **64 deaths**
 - **Median age of deceased patients 51 years**

Presenting Symptoms

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Pulmonale klachten

- Dyspnoe 85%
- Hoesten 85%
- Thoracale pijn 52%
- Hemoptoe 8%

Systemische klachten

- Koorts 82%
- Koude rillingen 60%

Gastrointestinale klachten

- Misselijkheid 66%
- Braken 61%
- Diarree 44%
- Buikpijn 34%

Diagnosis

Confirmed:

- **Use of E-Cigarette/Dabbing within 90 days**
- **Radiographic abnormalities on CXR or CT**
- **Absence of pulmonary infections on initial work-up**
- **No evidence of alternative plausible condition**

Beeldvorming

- Bilaterale opacities zijn typisch
- De opacities zijn grotendeels matglas opacities (Groundglas opacities (GGO))
- Soms subpleurale gebieden gespaard
- Pleuravocht komt weinig voor

Beeldvorming

- Diffuse alveolar damage (DAD) – Dependent consolidation, diffuse ground glass, airbronchograms.
- Acute eosinophilic pneumonia – Nodular areas of consolidation, diffuse ground glass, septal thickening, small amount of pleural fluid.
- Hypersensitivity pneumonitis (HP) – Centrilobular ground glass opacities anteriorly and moreconfluent ground glass opacities in dependent areas, and lobules of mosaic attenuation.
- Organizing pneumonia – Diffuse en multifocal.

Table 1: Patterns of disease shown in case reports of vaping-associated pulmonary illnesses: an overview of the medical literature up to Oct. 30, 2019*

Type of lung injury or predominant disease pattern	No. of cases	Age and sex	Associated imaging findings	Level of care required
Organizing pneumonia ^{10–13,26}	12	64M, 40F, 54M, 22M, 20M, 21M, 28M, 19M, 28M, 38M, 35M, 39M	1 patchy infiltrates, 11 diffuse GGO, 1 tree in bud, 1 pneumothorax with bilateral central opacities, bilateral reticulonodular opacities with subpleural sparing	7 hospital ward, 2 ICU, 3 unknown
Acute fibrinous pneumonitis with organization ²⁶	11‡	44M, 42M, 51M, 25M, 21M, 34F, 28M, 54F, 67M, 19M, 40M	5 diffuse GGO, 2 bilateral centrilobular GGO, 1 perihilar GGO, 1 tree in bud, 1 diffuse bronchocentric micronodular GGO, 1 diffuse bilateral opacities	11 unknown
Lipoid pneumonia ^{17–21}	10	42F, “young” F, 35F, 31F, 20\$, 23\$, 23\$, 25\$, 29\$, 47\$	8 diffuse GGO, 3 “crazy paving,” 1 consolidation, 1 basilar GGO	6 hospital ward, 4 ICU
Acute alveolitis or diffuse alveolar damage ^{9,13,26–28}	8¶	46M, 33M, 35M, 61M, 47F, 21M, 34F, 28M	6 bilateral diffuse GGO, 1 traction bronchiectasis	1 hospital ward, 6 ICU, 1 unknown
Pneumomediastinum or pneumothorax ^{29–33}	6	17M, 16M, 21M, 15M, 16M, 18M	2 pneumomediastinum, 1 tension pneumothorax, 3 nontension pneumothorax	6 hospital ward
Hypersensitivity pneumonitis ^{5–8}	4	73F, 16F, 23M, 18F	2 diffuse GGO, 2 septal thickening, 1 traction bronchiectasis, 1 honeycombing, 1 diffuse nodules	2 hospital ward, 1 ICU with ECMO, 1 ICU without ECMO
Granulomatous disease ^{34,35}	2	43F, 34F	2 bilateral nodules	2 hospital ward
Eosinophilic pneumonia ^{15,16}	2	18F, 20M	2 diffuse GGO, 1 airspace disease, 1 coalescing nodules	1 ICU, 1 hospital ward
Status asthmaticus ³⁶	2	16M, 14F	2 pneumomediastinum	2 ICU with ECMO
Bronchitis ^{37,38}	2	43M, 56F	1 no acute abnormality, 1 diffuse GGO, 1 “crazy paving”	1 outpatient, 1 hospital ward

**TABLE 2. Electronic Cigarette—Associated
Pulmonary Syndromes**

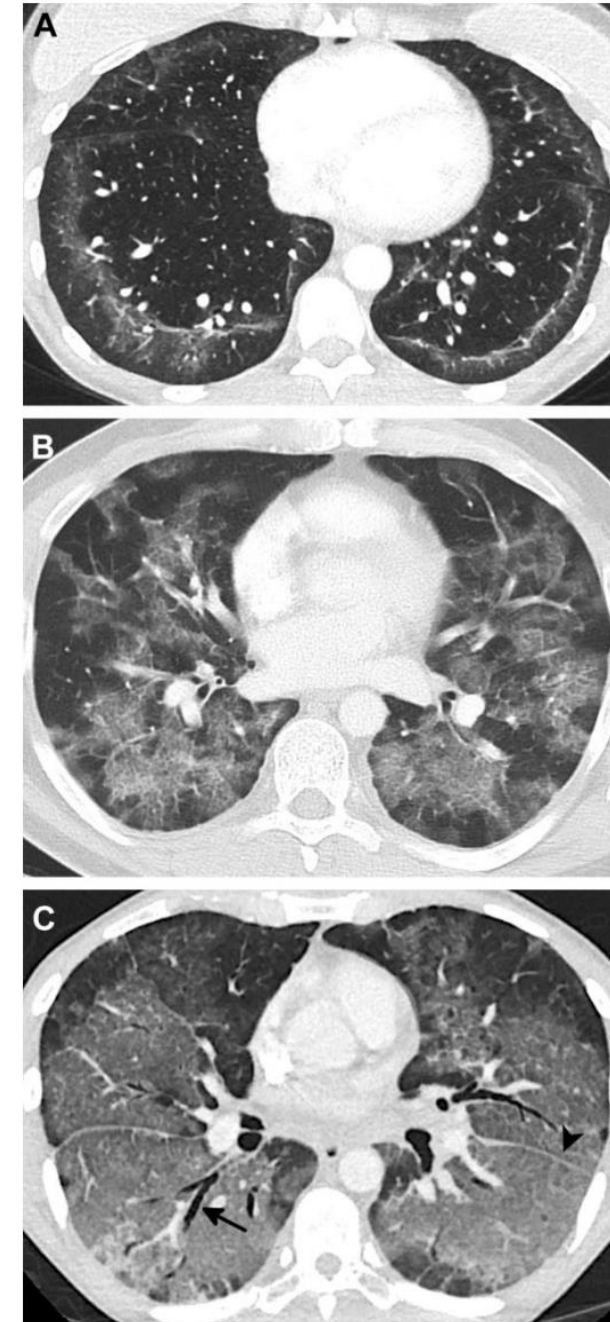
Inhalation injury	
Exogenous lipoid pneumonia	
Hypersensitivity pneumonitis	
Acute eosinophilic pneumonia	
Diffuse alveolar hemorrhage	
Pneumothorax/pneumomediastinum	
Acute respiratory distress syndrome	
Respiratory bronchiolitis-interstitial lung disease	
Bronchiolitis obliterans	
Acute fibrinous pneumonitis	
Organizing pneumonia	
Granulomatous pneumonitis	

Chest CT findings in EVALI

A: Lower-lobe predominant organizing pneumonia (OP) pattern subpleural bands of ground-glass opacity (GGO)

B: Diffuse GGO OP pattern: Subpleural and lobular sparing.

C: Severe injury with diffuse GGO with diffuse alveolar damage pattern.



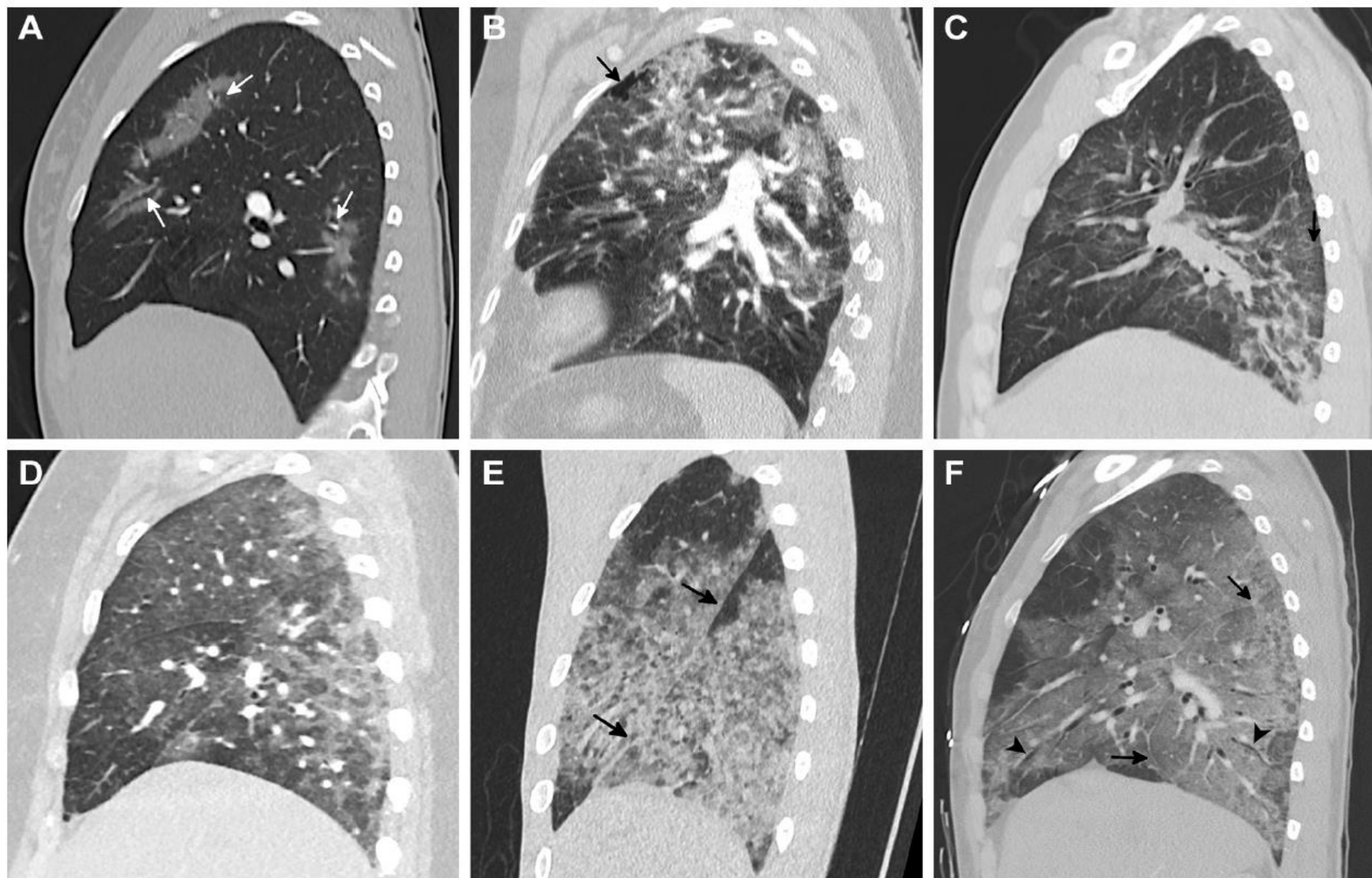


Figure 6 – A-F, Spectrum of parenchymal injury patterns in e-cigarette or vaping product use-associated lung injury. A, Sagittal reformatted CT image of a patchy organizing pneumonia (OP) pattern in a 19-year-old woman who vaped tetrahydrocannabinol (THC) daily shows a qualitatively mild injury. There are multiple areas of peribronchovascular sparing in the patchy foci of ground-glass opacity (GGO) (arrows). B, Sagittal reformatted CT image of an upper lobe predominant OP pattern in a 59-year-old woman who vaped nicotine daily. There is an associated focus of paraseptal emphysema (arrow). C, Sagittal reformatted CT image of a lower lobe predominant OP pattern in a 31-year-old man who vaped THC products multiple times per week shows a qualitatively moderate injury with a few areas of consolidation and mild septal thickening (arrow). Although the lower-lobe parenchymal OP pattern still involves all five lobes in nearly all patients, the lower lobes are more severely affected. D, Sagittal reformatted CT image of a diffuse GGO OP pattern in a 19-year-old woman who vaped THC oil daily shows a qualitatively severe injury with diffuse craniocaudal GGO with areas of subpleural and lobular sparing. E, Sagittal reformatted CT image of a diffuse consolidative OP pattern in a 19-year-old man who vaped both THC and nicotine products shows a qualitatively severe injury with a greater degree of consolidation compared with GGO. There is no fissural displacement (arrows) and no airway dilation. It is unclear whether this represents a severe form of OP or an early exudative phase of diffuse alveolar damage (DAD). F, Sagittal reformatted CT image of a DAD pattern in a 25-year-old man who vaped THC daily shows diffuse GGO with inferior displacement of the right major fissure (arrows) and lack of tapering of the subsegmental bronchi, which are mildly dilated (arrowheads). He died 3 weeks later.

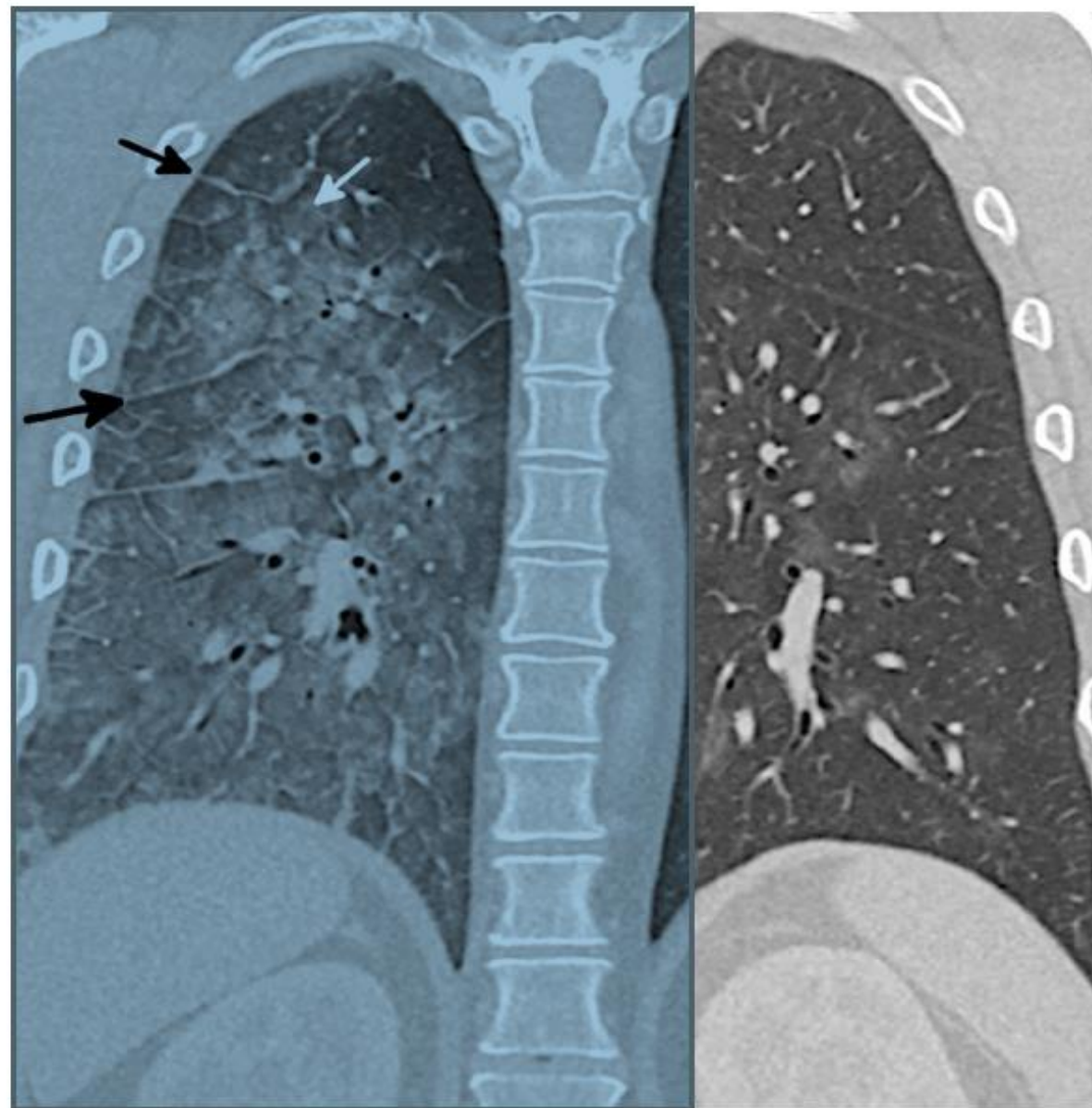


Figure 8 – Diffuse alveolar hemorrhage (DAH) pattern in e-cigarette or vaping product use-associated lung injury. Coronal reformatted CT image of a 42-year-old man presenting with hemoptysis shows asymmetrical ground-glass opacity predominantly on the right with septal thickening (black arrows) and ill-defined ground-glass acinar nodules (white arrow) that fill most of the secondary lobule, a finding common in DAH. BAL confirmed the diagnosis, and the patient rapidly improved with steroids. DAH was the only pattern that was commonly asymmetrical.

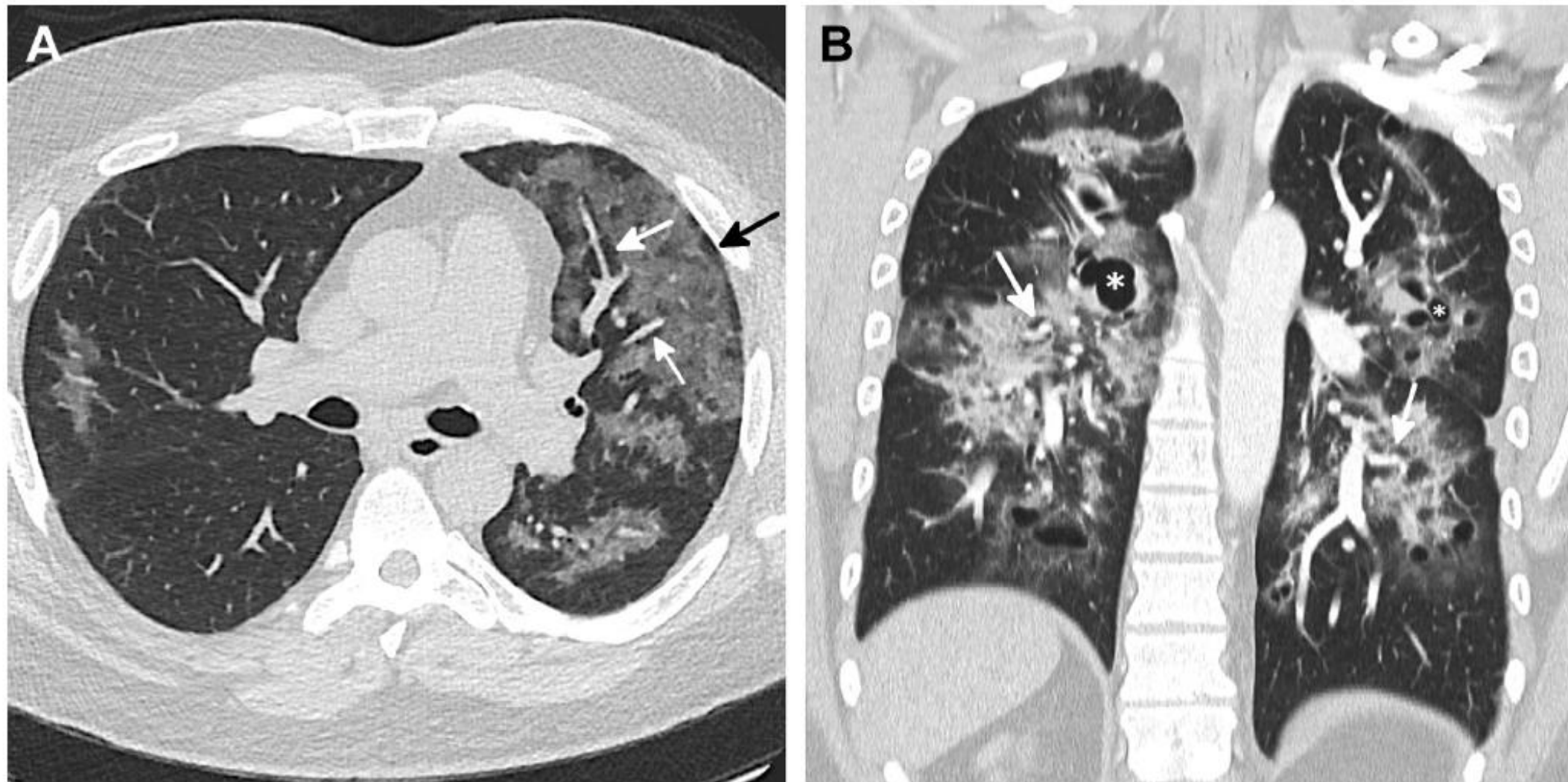
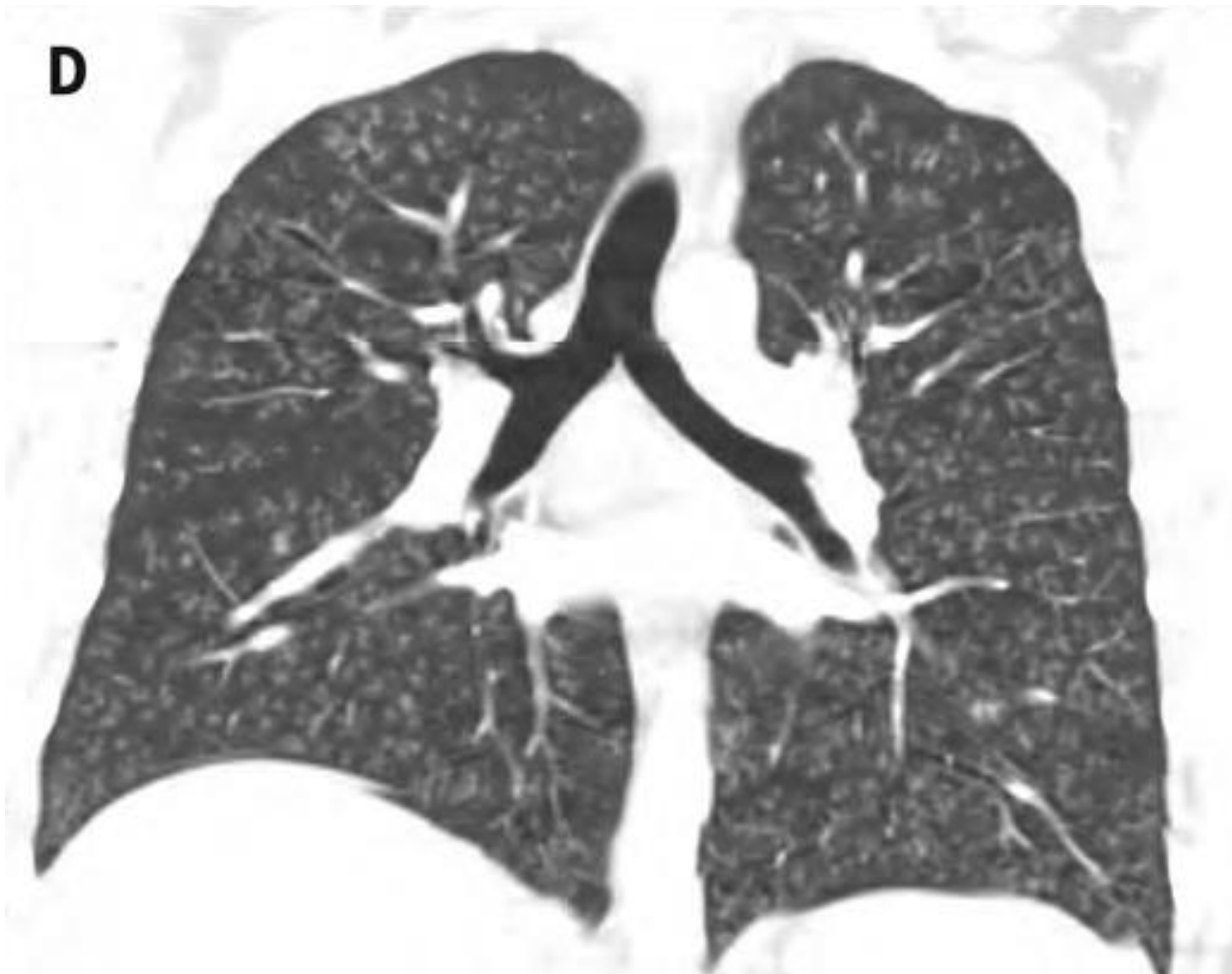
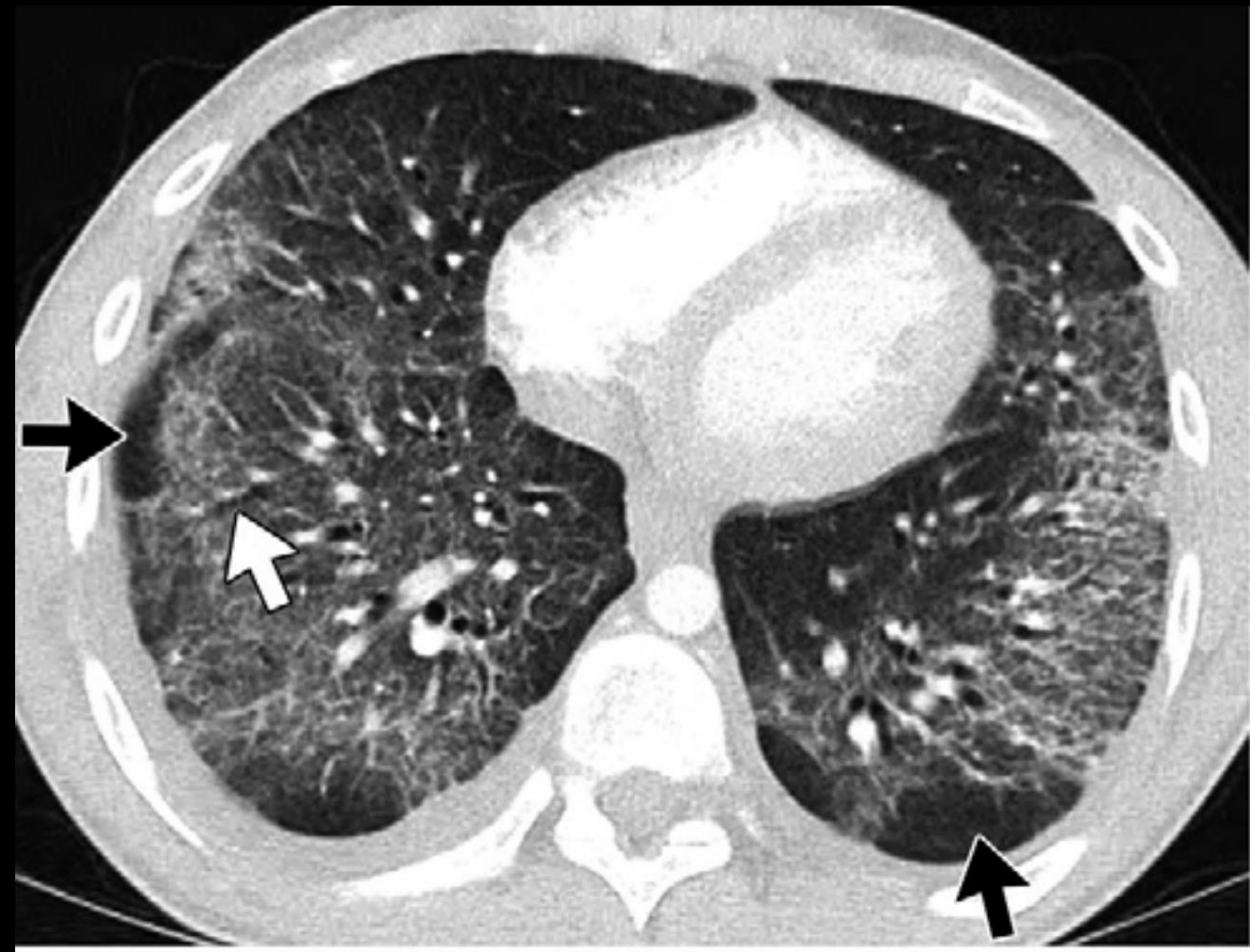


Figure 9 – A-B, Atypical patterns in e-cigarette or vaping-induced lung injury (EVALI). A, CT image of a 49-year-old man who vaped tetrahydrocannabinol (THC) and nicotine shows common imaging findings associated with a diffuse organizing pneumonia (OP) pattern of EVALI in the left lung with diffuse ground-glass opacity (GGO) with subpleural (black arrow) and peribronchovascular (PBV) sparing (white arrows) with only minimal involvement of the right lung. B, Coronal reformatted CT image of a 36-year-old man who vaped nicotine presenting with dyspnea and cough for nearly 4 months shows a diffuse GGO OP pattern with PBV sparing (arrows). Additionally, there are numerous cystic spaces, some with surrounding foci of consolidation (asterisks), which led to the atypical classification. The cysts are likely caused by areas of parenchymal destruction and have been reported.

D



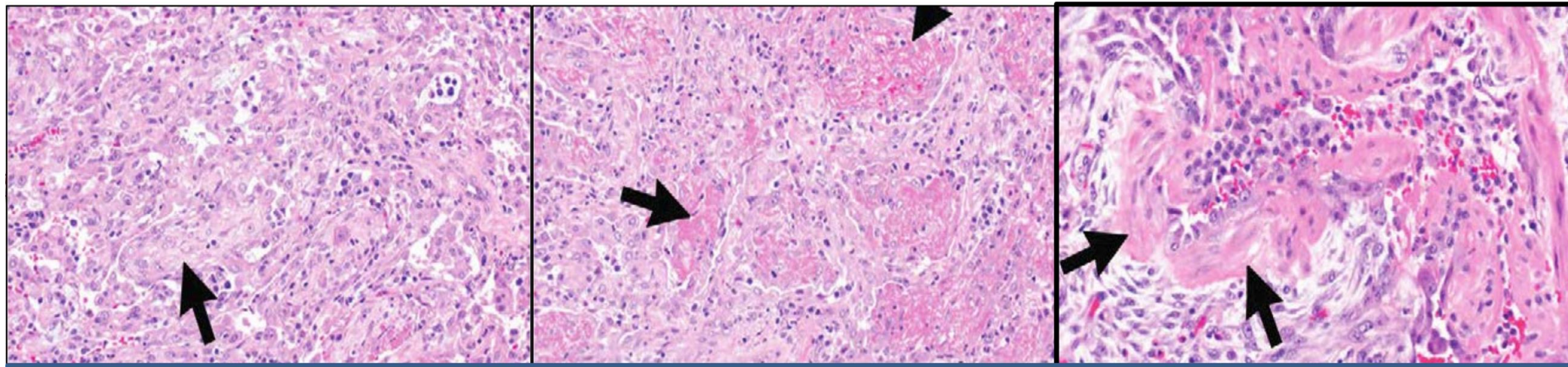
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Bronchoscopy

- **Generally for progressive or severe symptoms**
- **Evaluation of infections**
- **No confirmatory testing for EVALI**
 - **Neutrophil predominance**
 - **Lipid Laden-Macrophages**
- **Relatively high complication rate reported**



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Pathology:

- Various histologic findings
 - No confirmatory diagnostic findings
 - Findings are consistent with acute inhalational lung injury
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- Acute fibrinous pneumonitis
 - Diffuse alveolar damage (DAD)
 - Foamy (lipid-laden) macrophages (seen in all cases),
 - Organizing pneumonia

Treatment

- **Supportive treatment as needed**
 - **Supplemental oxygen**
 - **50% require ICU care**
 - **NIV**
 - **Intubation (25%)**
 - **ECMO**
- **Empiric antimicrobials**
- **Corticosteroids**

Treatment

- **Empiric antimicrobials**
 - Majority of patients started on therapy
 - Duration dictated by course and infectious work-up
- **Corticosteroids**
 - No formal studies
 - Threshold to begin varies
 - 0.5 to 1 mg/kg per day for 5-10 days
 - May have flare after stopping

