

E-Cigarette or Vaping Product Use Associated Lung Injury

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New Brunswick Internal Medicine Update

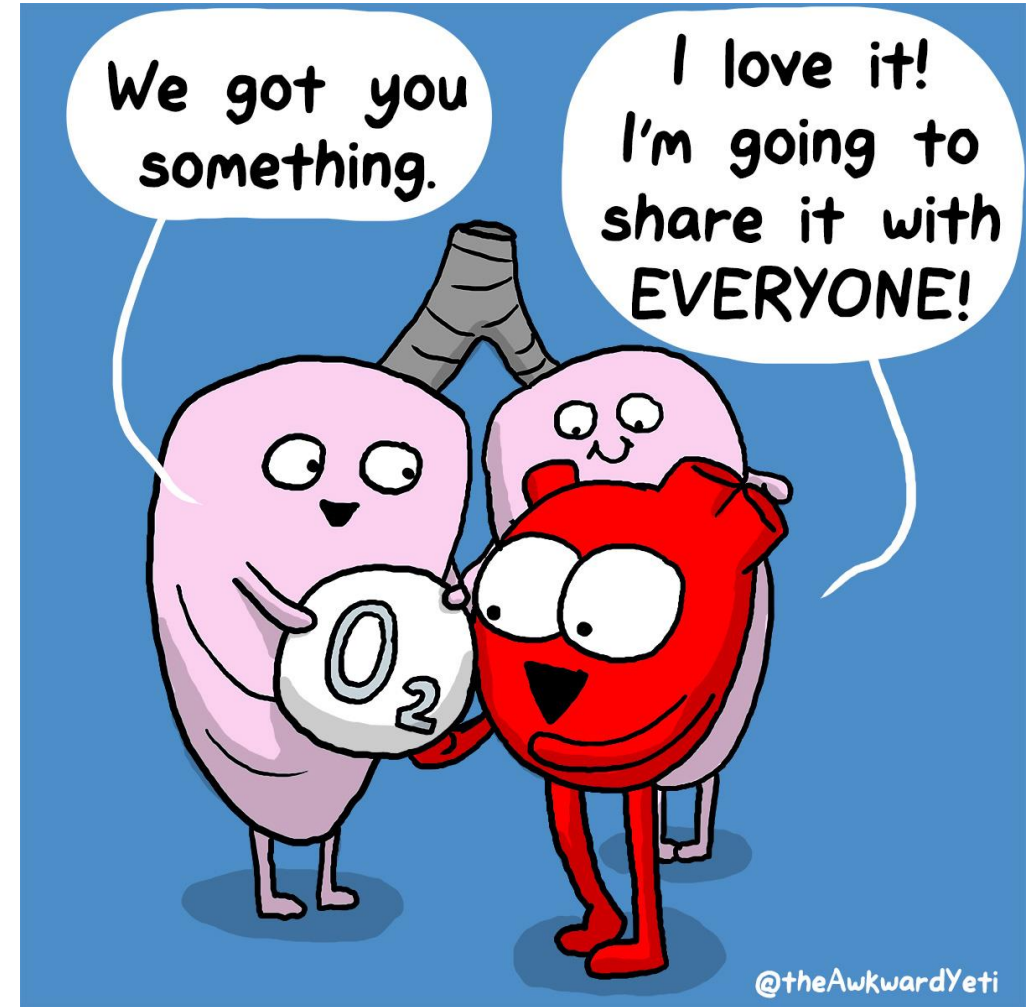
Disclosures

- None



Objectives

- At the end of this presentation participants will be able to
 - Describe respiratory harms caused by e-cigarette/vaping devices
 - Recognize the characteristics of e-cigarette or vaping product use associated lung injury (EVALI)
 - Feel more comfortable sharing information with patients (and friends! and family members!) about the risks associated with e-cigarette/vaping device use

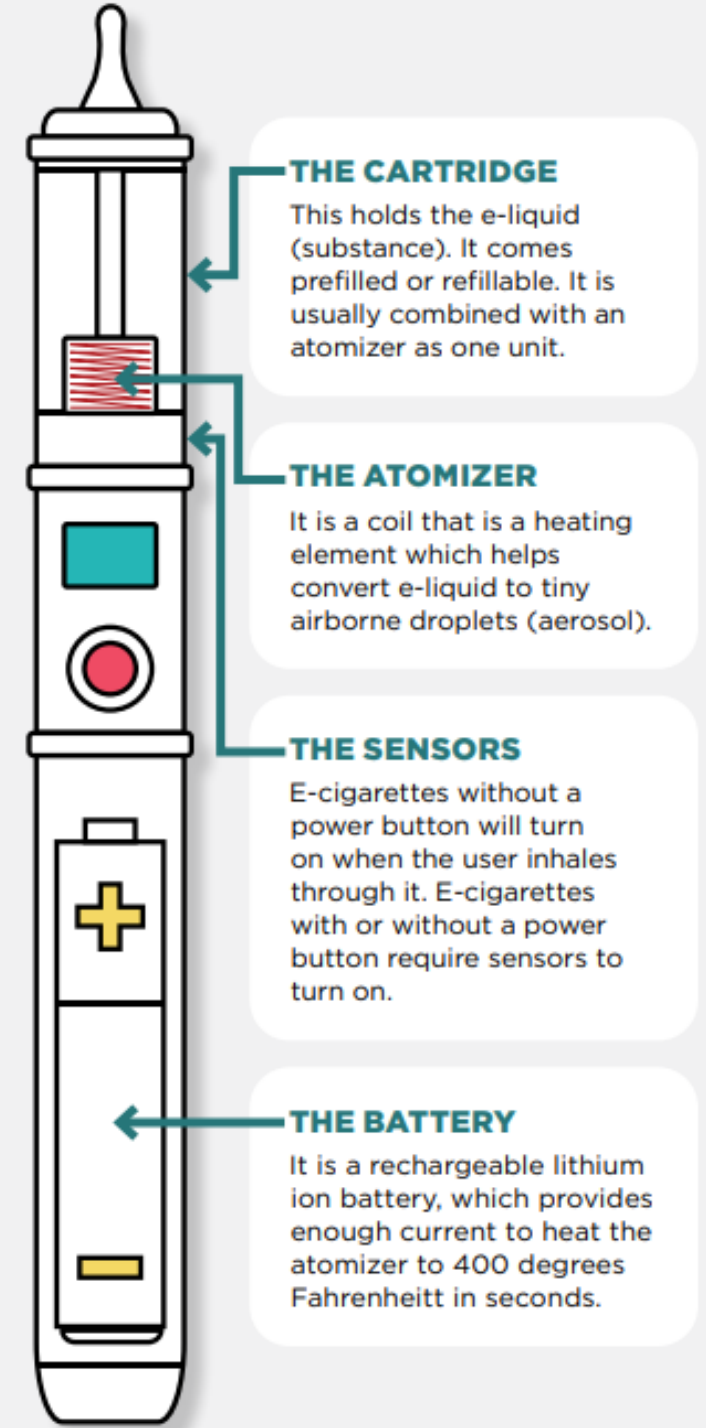




- Designed by a Chinese pharmacist as a smoking-cessation product
- Introduced in the US in 2006 independently of Big Tobacco
- Vaping products have many names (mods, vapes, sub-ohms, vape pens, e-hookahs, tanks, electronic nicotine delivery systems (ENDS))

Anatomy of an E-cigarette

- Vaping is the act of inhaling a heated, aerosolized substance
- Smoking is the inhalation of a burned substance
- Smoking occurs at much higher temperatures than vaping and leads to a much more complex mixture of chemicals





1st GENERATION

Disposable
e-cigarettes



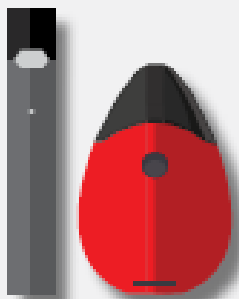
2nd GENERATION

E-cigarettes
with prefilled
or refillable
cartridge



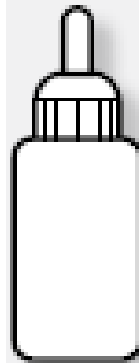
3rd GENERATION

Tanks or Mods
(refillable)



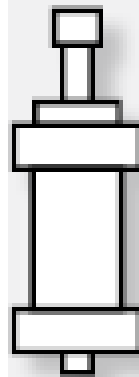
4th GENERATION

Pod Mods
(prefilled or
refillable)



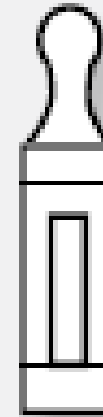
E-Liquid

E-liquid is contained in a pod, cartridge or tank. It is made up of a mixture of substances that includes nicotine, cannabis, and/or flavoring.



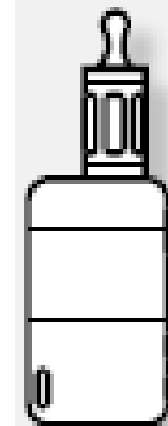
Sub-Ohm Tank

It is made of plastic or metal with transparent casing so liquid levels can be seen. It contains a lower resistance coil that allows the liquid to heat up faster.



Cartridge

It is made of plastic or metal with transparent casing so liquid levels can be seen. It contains an atomizer that heats up the e-liquid.

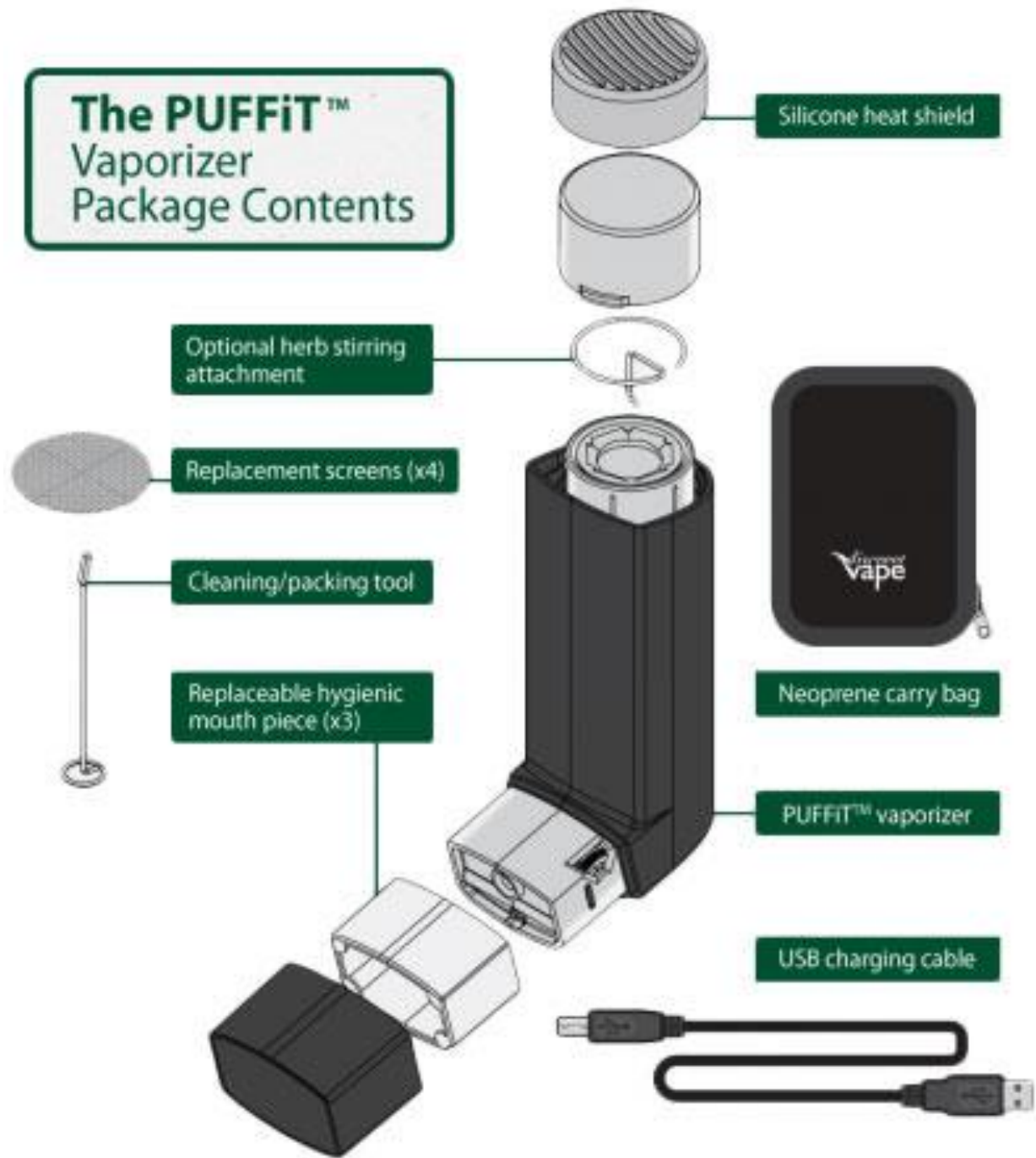


Mod Box

It is a 3rd generation device that is modifiable ("Mod") allowing users to change the voltage, coils and wicks.

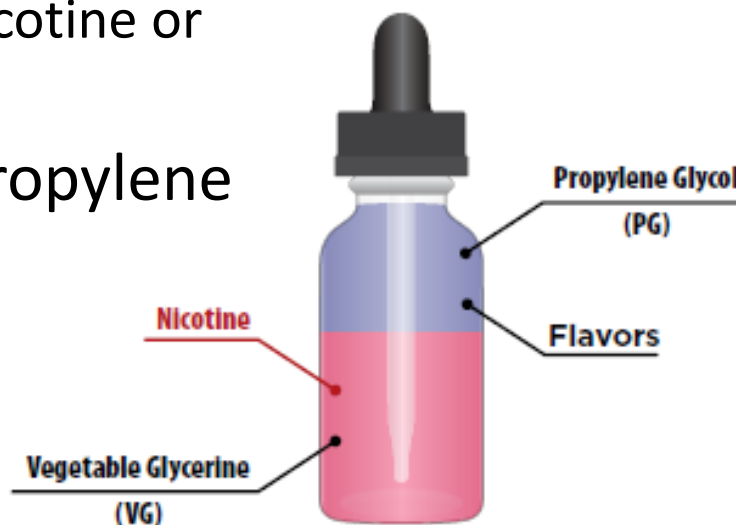


The PUFFIT™ Vaporizer Package Contents

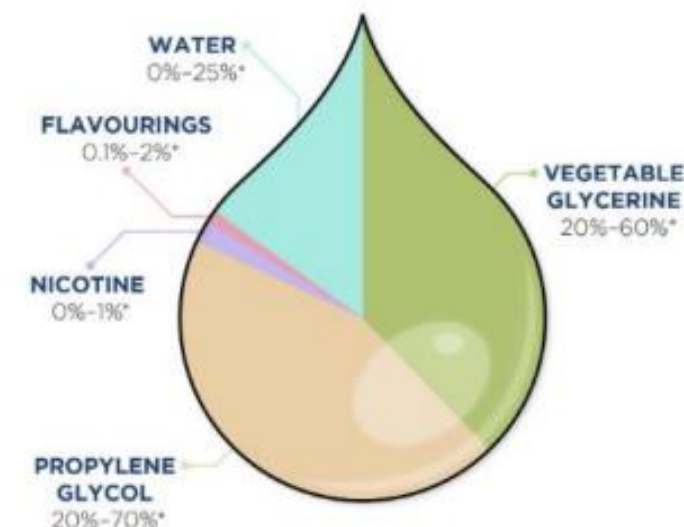


E-Liquid/Vape Juice

- What's in it?
 - ???
 - FDA testing has demonstrated substances not listed as ingredients
 - Variable origin sources
 - Not all solutions contain nicotine or cannabis
- Vegetable glycerine and propylene glycol used as humectants
- “Food grade” flavouring



WHAT'S IN AN eLIQUID?



*Quantities shown are for illustrative purposes only and are not exact. Portions of each ingredient vary depending on which Vype device is used.



Flavour 1

Flavour 2

Flavour 3

DIY EJUICE STARTER KIT

★★★★★ 12 Reviews

\$30.49

RATIO

50VG/50PG

100%VG

100%PG

50VG/50PEG400

100%PEG400

QUANTITY

- +

ADD TO CART

ADD TO WISHLIST

Whether you are wondering [how to make diy e-juice](#), or you are an advanced flavour 'mixologist', you will be pleased to find only the necessary quality items which will help you to be more efficient with mixing. [Contact us](#) if you have any questions.

*CHOOSE 3 x 5ml bottles of [high strength flavour concentrates](#)

How much nicotine do you get?

Cigarettes

- Depends on
 - Tobacco content
 - Filters and vents
 - Smoking behaviours

E-cigarettes/Vaping Products

- Depends on
 - Nicotine concentration
 - In Canada 0-66 mg/mL
 - Other components of the e-liquid
 - Device characteristics
 - Vaping behaviours
 - User experience
 - Puffing intensity

Vaping aerosol

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

E-liquid component	Chemical or compound
Carrier solution	<ul style="list-style-type: none">• Propylene glycol

**NOT JUST WATER
VAPOUR**

Volatile organic compounds (VOCs)

Gasoline

Polycyclic aromatic hydrocarbons (PAHs)

Vehicle exhaust

Tiny particles

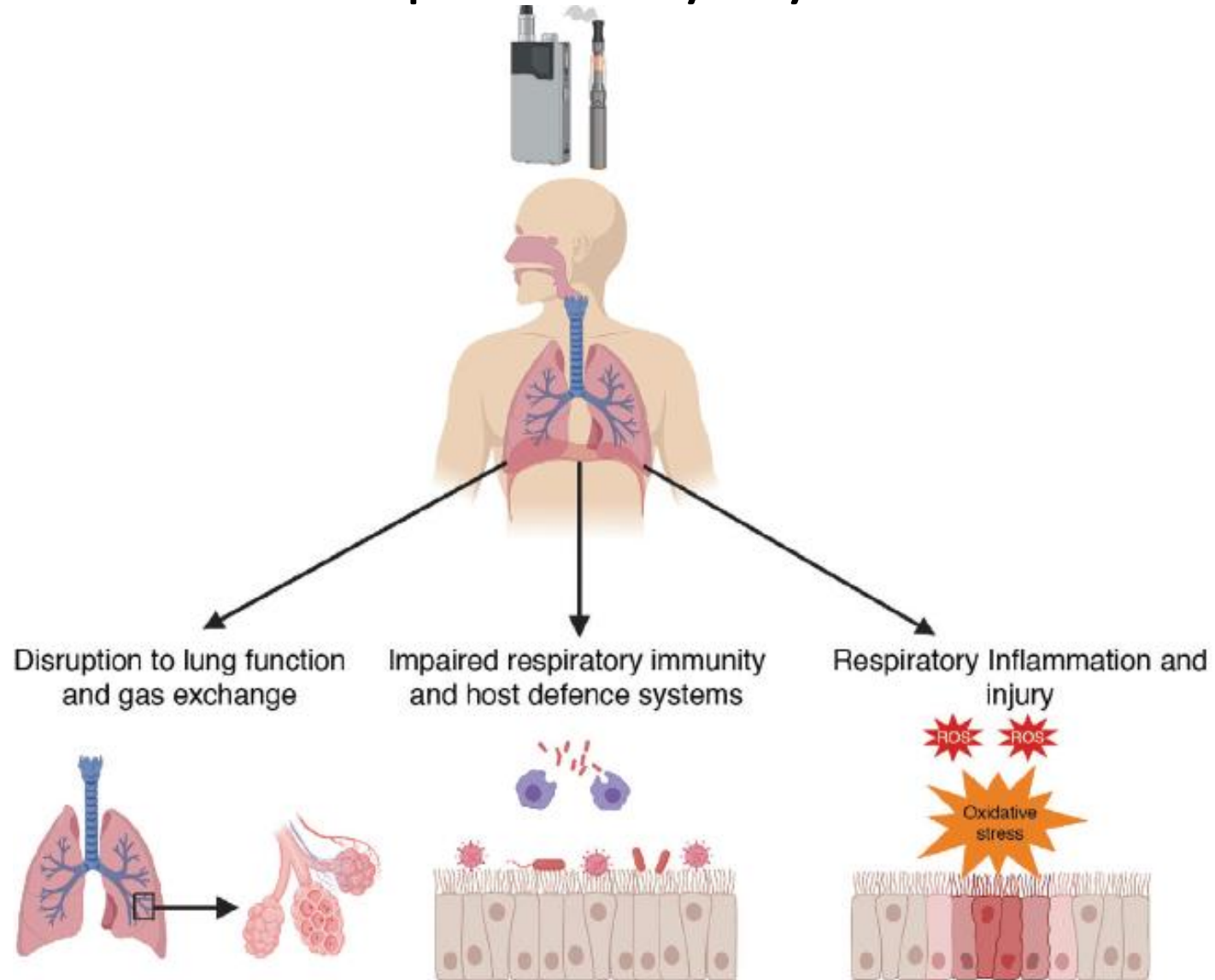
Wildfire smoke

- Particulates
- Trace metal elements
- Volatile organic compounds

Contaminants

- Bacterial endotoxins
- Fungal glucans CMAJ, 2019;191(48):E1321

Effects on the respiratory system



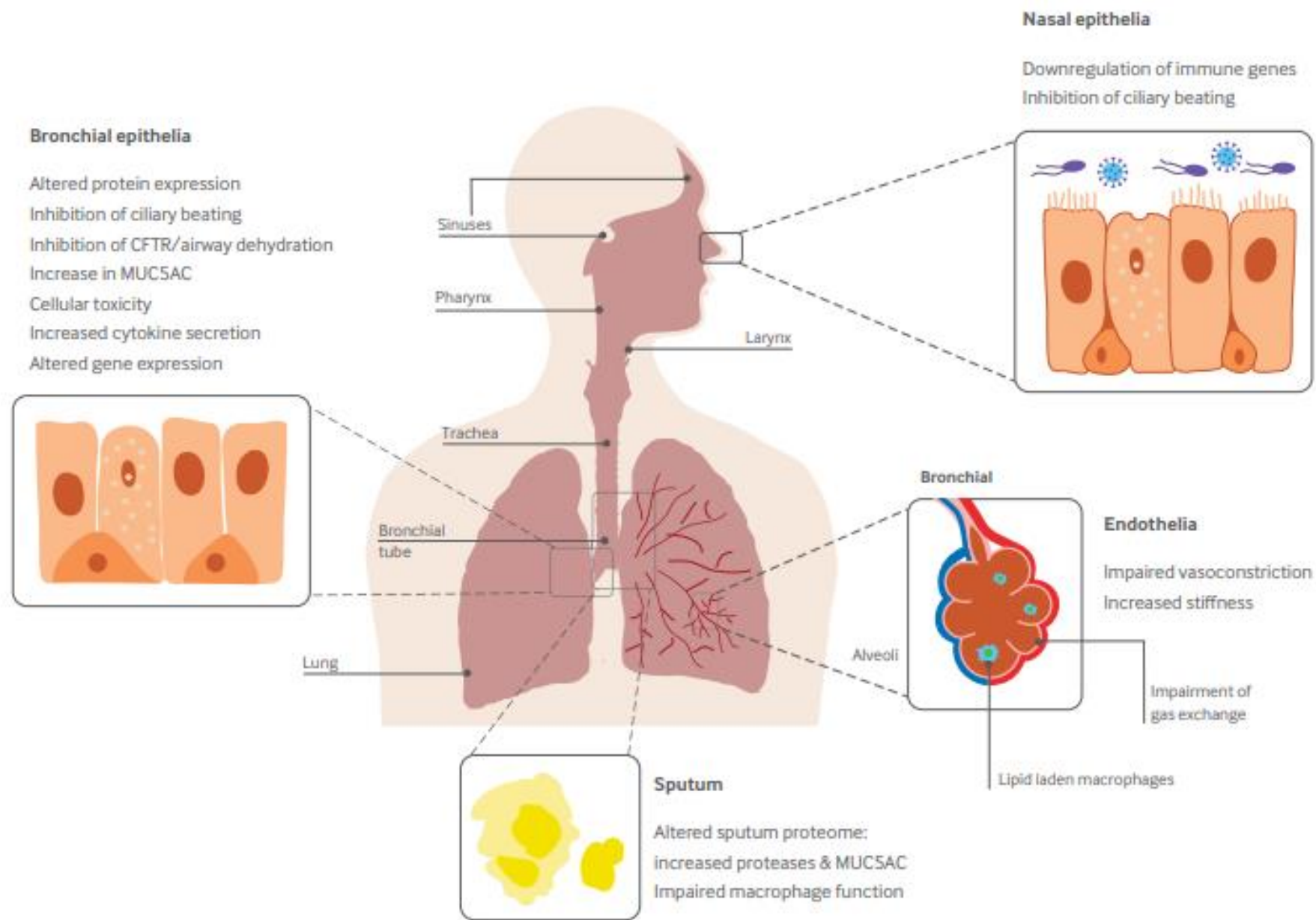


Fig 1 | Reported effects of vaping on the human pulmonary system

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

- Between 2012-Aug 2019, 30 publications identifying vaping-associated pulmonary insults. No reported deaths
- EVALI was described summer 2019 due to an outbreak of severe unexplained respiratory illness in Wisconsin and Illinois
- Common feature of using an e-cigarette/vaping product in 90 days before symptom onset

EVALI

TABLE. CDC surveillance case definitions* for severe pulmonary disease associated with e-cigarette use — August 30, 2019

Case classification	Criteria
Confirmed	<p>Using an e-cigarette (“vaping”) or dabbing[†] during the 90 days before symptom onset</p> <p>AND</p> <p>Pulmonary infiltrate, such as opacities on plain film chest radiograph or ground-glass opacities on chest computed tomography</p> <p>AND</p> <p>Absence of pulmonary infection on initial work-up: Minimum criteria include negative respiratory viral panel, influenza polymerase chain reaction or rapid test if local epidemiology supports testing. All other clinically indicated respiratory infectious disease testing (e.g., urine antigen for <i>Streptococcus pneumoniae</i> and <i>Legionella</i>, sputum culture if productive cough, bronchoalveolar lavage culture if done, blood culture, human immunodeficiency virus–related opportunistic respiratory infections if appropriate) must be negative</p> <p>AND</p> <p>No evidence in medical record of alternative plausible diagnoses (e.g., cardiac, rheumatologic, or neoplastic process).</p>
Probable	<p>Using an e-cigarette (“vaping”) or dabbing[†] in 90 days before symptom onset</p> <p>AND</p> <p>Pulmonary infiltrate, such as opacities on plain film chest radiograph or ground-glass opacities on chest computed tomography</p> <p>AND</p> <p>Infection identified via culture or polymerase chain reaction, but clinical team[§] believes this is not the sole cause of the underlying respiratory disease process OR minimum criteria to rule out pulmonary infection not met (testing not performed) and clinical team[§] believes this is not the sole cause of the underlying respiratory disease process</p> <p>AND</p> <p>No evidence in medical record of alternative plausible diagnoses (e.g., cardiac, rheumatologic, or neoplastic process).</p>

* These surveillance case definitions are meant for surveillance and not clinical diagnosis; they are subject to change and will be updated as additional information becomes available if needed.

[†] Using an electronic device (e.g., electronic nicotine delivery system (ENDS), electronic cigarette (e-cigarette), vaporizer, vape(s), vape pen, dab pen, or other device) or dabbing to inhale substances (e.g., nicotine, marijuana, tetrahydrocannabinol, tetrahydrocannabinol concentrates, cannabinoids, synthetic cannabinoids, flavorings, or other substances).

[§] Clinical team caring for the patient.

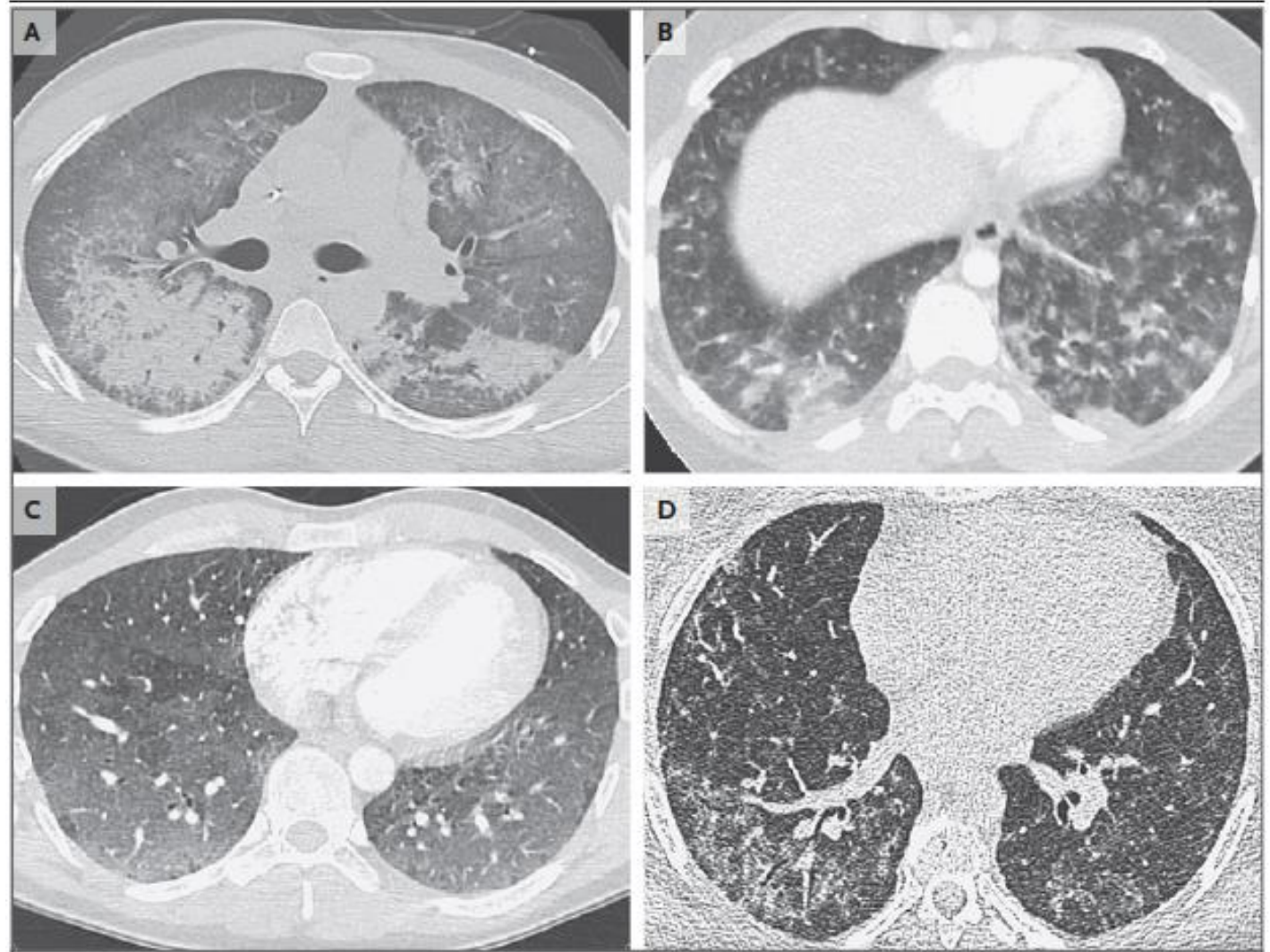
Imaging examples

A: 20 yo M, diffuse alveolar damage with dependent consolidation and diffuse ground-glass opacity

B: 19 yo F, acute eosinophilic pneumonia with diffuse nodular areas of consolidation and ground-glass opacity

C: 35 yo M, hypersensitivity pneumonitis with extensive centrilobular ground-glass attenuation nodules with lobules of mosaic attenuation

D: 49 yo F, giant-cell interstitial pneumonia with fibrosis characterized by peripheral reticulation, ground-glass opacity and mild traction bronchiectasis



Pulmonary Illness Related to E-Cigarette use in Illinois and Wisconsin – Final Report

Characteristic	Values
Median age (range) – yr	21 (15-53)
Male sex – no./total no. (%)	77/98 (79)
Median duration of symptoms before presentation (range) - days	6 (0-155)
Any respiratory symptom – no./total no. (%)	95/98 (97)
Any gastrointestinal symptom – no./total no. (%)	75/98 (77)
Any constitutional symptom – no./total no. (%)	98/98 (100)
Hospitalization – no./total no. (%)	93/98 (95%)
Admission to intensive care unit – no./total no. (%)	52/98 (53%)
Intubation and mechanical ventilation – no./total no. (%)	25/98 (26%)
Median duration of hospitalization (range) – days	6 (1-72)
Death – no./total no. (%)	2/98 (2)

Cases to date

Canada (PHAC)

- As of Aug 14, 2020
 - 20 cases reported to PHAC
 - BC (5), AB (1), ON (5), QC (6), NB (2), NL (1)
 - 5 in each age group 15-19, 20-34, 35-49, 50+ years
 - 12 male
 - No deaths

USA (CDC)

- As of Feb 18, 2020
 - 2807 hospitalized cases or deaths
 - All 50 states, DC, Puerto Rico, US Virgin Islands
 - 68 deaths

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.

Vitamin E acetate in THC products

- Vitamin E acetate (VEA) identified in THC product seizures in multiple states in 2019, not 2018
- FDA analysis (as of Feb 2020)
 - 77% of samples contained THC
 - 50% of THC products contained VEA as a diluent
 - 29% of THC products contained other diluents such as medium chain triglycerides
- FDA analysis of samples connected to 93 patients with CDC case numbers
 - 73% contained THC, 81% contained VEA, 32% contained aliphatic esters

Vitamin E acetate

- Similar colour and viscosity as THC
- Thickener used to cut THC vape liquid
- Possible mechanism:
 - VEA disruption of surfactant function
 - Thermal decomposition leads to formative reactive volatile organic compounds
- Although safe for ingestion and topical use (“food grade”), not safe for inhalation

EVALI Cases

- Emergency department visits related to e-cigarette/vaping products declined after September 2019
 - Increased public awareness of the risk associated with THC-containing vape products
 - Removal of vitamin E acetate from some products
 - Increased product regulation
 - SARS-CoV-2
- Vitamin E acetate is not the only culprit

Products vaped:

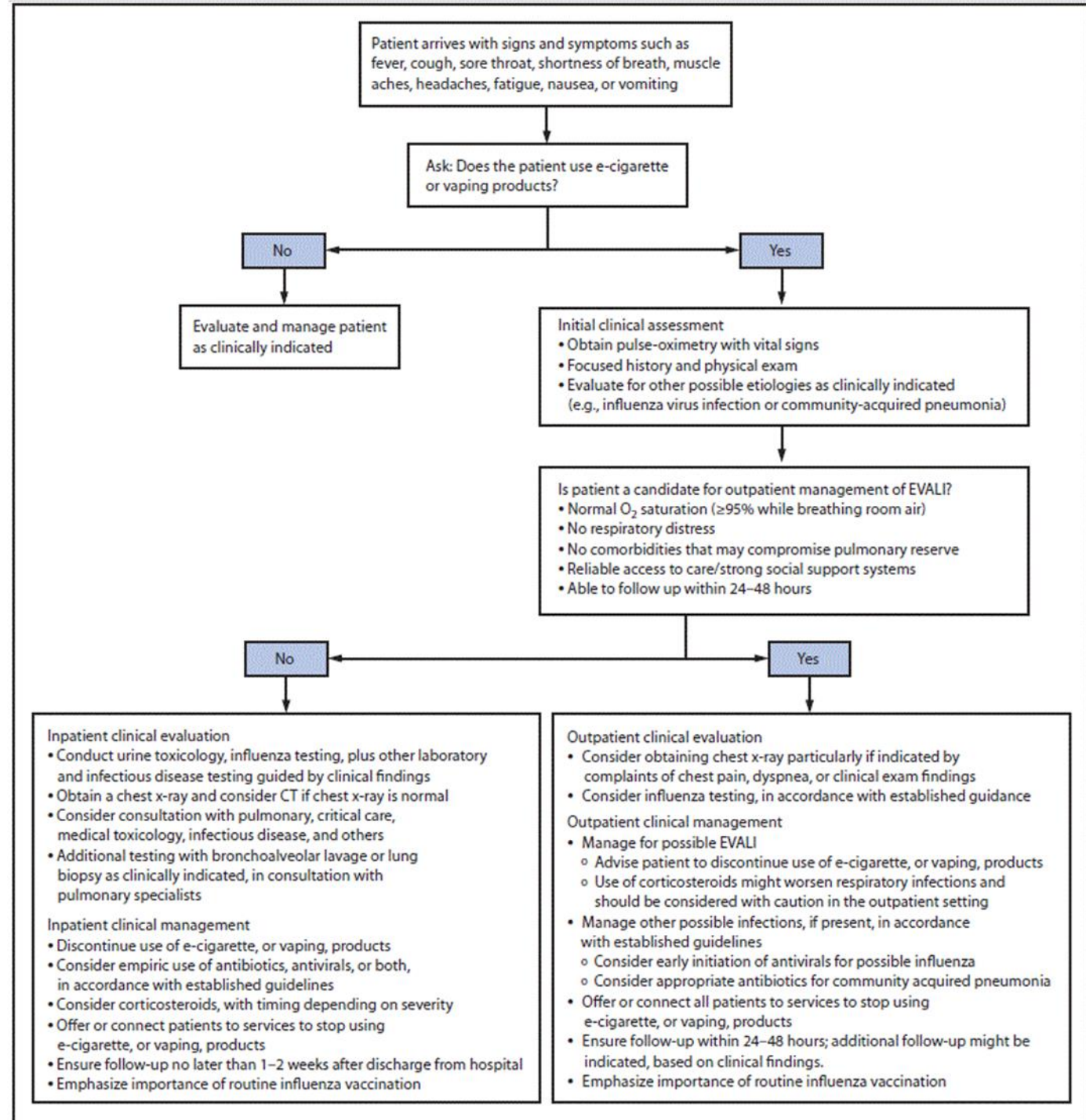
Exposure ¹	Number of cases
Nicotine only	11
Tetrahydrocannabinol (THC) only	5
Flavoured vaping liquid only	1
Nicotine, THC and other substances	3

¹

This information is self reported and has not been validated as part of the ongoing outbreak investigation. Eight patients reported buying their vaping products in Canada and three reported buying online. Information about purchase location is not available for nine (9) cases.

Algorithm for management

NOTE: Published before SARS-CoV-2



Patient arrives with signs and symptoms such as fever, cough, sore throat, shortness of breath, muscle aches, headaches, fatigue, nausea, or vomiting

Ask: Does the patient use e-cigarette or vaping products?

ASK WHAT, HOW, AND WHERE

WHAT:

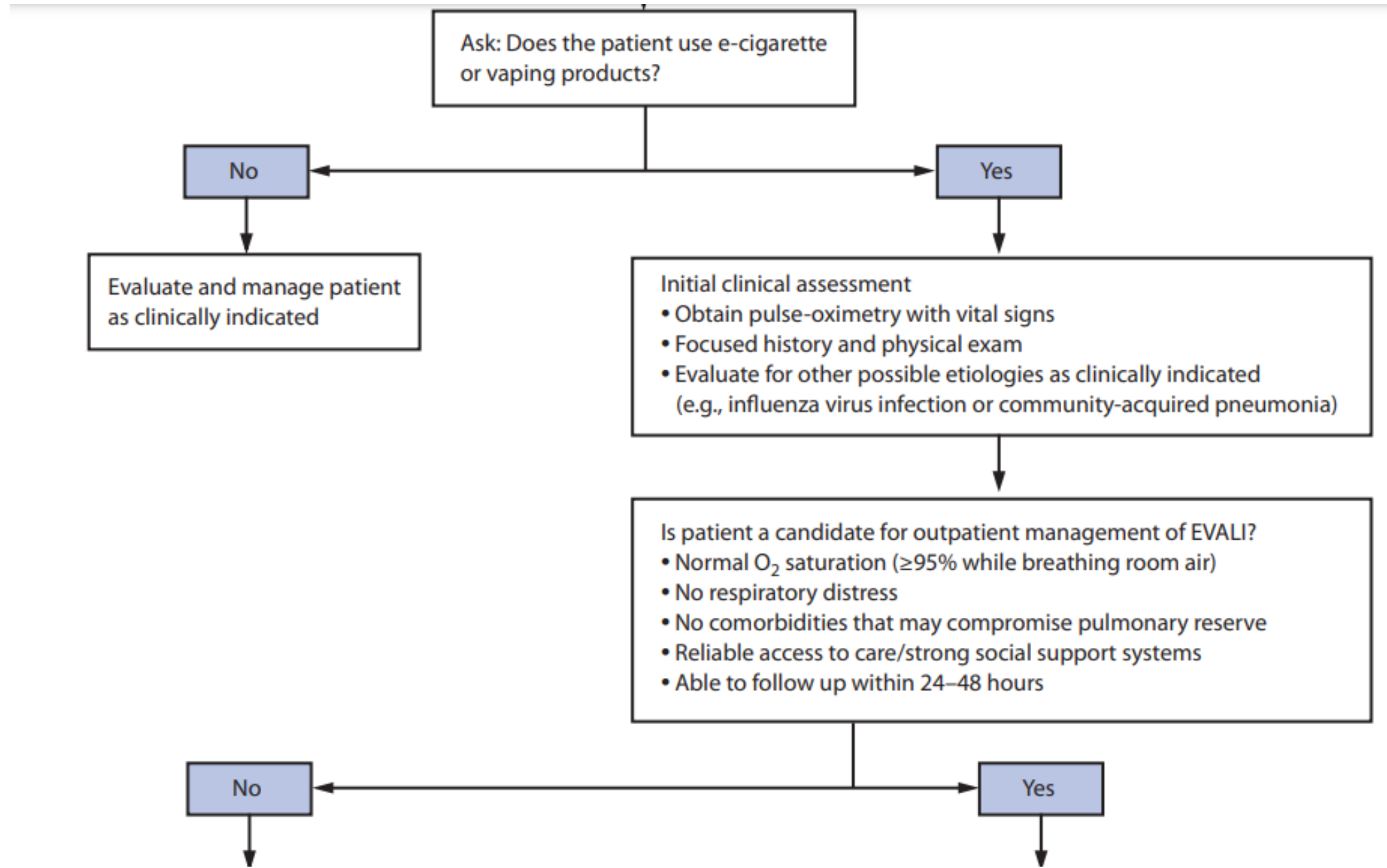
- Ask the patient if they have used or tried e-cigarettes, or vaping, products. If the answer is yes, ask for more details about the products, including the types of substances used.
- » Most EVALI patients report using THC-containing products before the onset of symptoms.

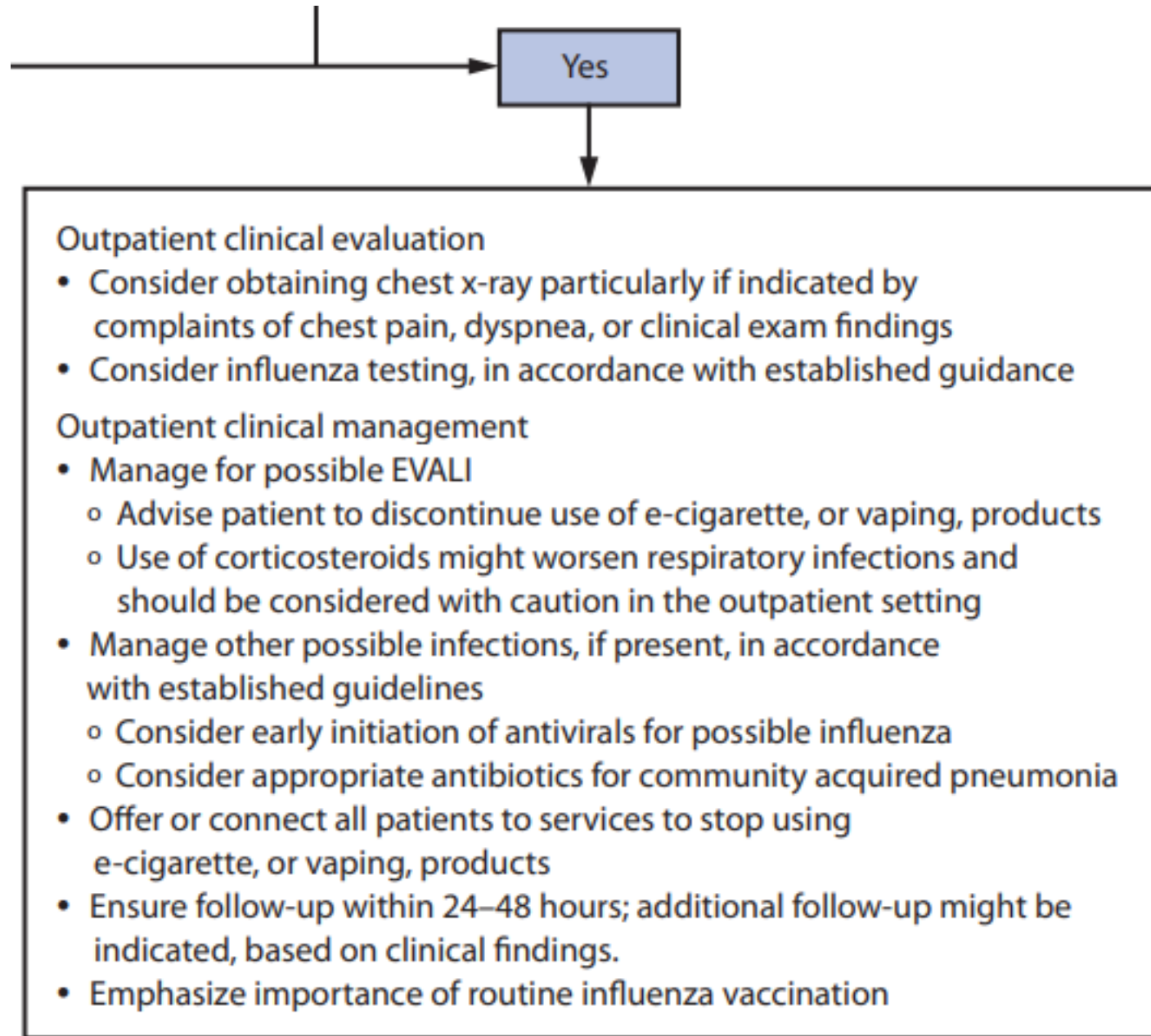
HOW:

- Ask how often patients have used these products, and when they last used the products.
- » Many EVALI patients report frequent (e.g. more than five times per day) use of e-cigarette, or vaping, products. One prompt that may help to determine usage is to ask how often the patient finishes or changes their cartridges?

WHERE:

- Ask where the e-cigarette, or vaping, products were obtained.
- » Most EVALI patients report using products from informal sources, including family, friends, online or in person dealers.





No

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graph TD; A[No] --> B[Inpatient clinical evaluation and management];
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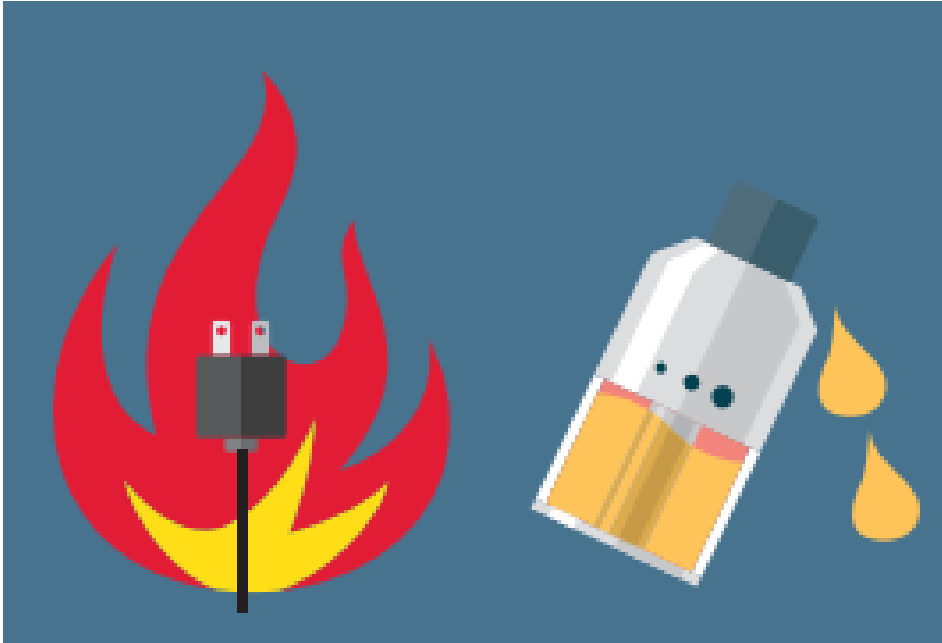
Inpatient clinical evaluation

- Conduct urine toxicology, influenza testing, plus other laboratory and infectious disease testing guided by clinical findings
- Obtain a chest x-ray and consider CT if chest x-ray is normal
- Consider consultation with pulmonary, critical care, medical toxicology, infectious disease, and others
- Additional testing with bronchoalveolar lavage or lung biopsy as clinically indicated, in consultation with pulmonary specialists

Inpatient clinical management

- Discontinue use of e-cigarette, or vaping, products
- Consider empiric use of antibiotics, antivirals, or both, in accordance with established guidelines
- Consider corticosteroids, with timing depending on severity
- Offer or connect patients to services to stop using e-cigarette, or vaping, products
- Ensure follow-up no later than 1–2 weeks after discharge from hospital
- Emphasize importance of routine influenza vaccination

Other risks to consider



- Device malfunctions
 - Defective batteries causing fires and explosions
 - Defective vaping products causing fires and explosions
- Device modifications
- Acute nicotine poisoning

In Summary

- Vaping products are not a harmless alternative to combustible smoking
- Users do not inhale 'just water vapour'
- There are many different ways vaping products can cause harm
- EVALI usually presents with respiratory, GI and constitutional symptoms and is a diagnosis of exclusion

Helpful online resources

- Canada.ca/vaping
- Physicians for a smoke-free Canada: <https://smoke-free.ca/>
- CDC: https://www.cdc.gov/tobacco/basic_information/e-cigarettes/index.htm
- The Lung Association
 - Lung.ca (Canadian)
 - Lung.org (American)
- FDA: <https://www.fda.gov/news-events/public-health-focus/lung-injuries-associated-use-vaping-products>
- Stanford Medicine Tobacco Prevention Toolkit