

**Turbulence Ahead: the
Pathophysiology of Vaping
and the Public Health Crisis**





CLINICAL ASSESSMENT

SYMPTOMS:

- SOB on exertion
- daily cough with white sputum
- Tachypneic, tachycardic



PATIENT HISTORY:

- Ex-cigarette smoker, switched to vaping ~3 years before admission.

IMPRESSION: Acute type 1 respiratory failure.

A frontal chest X-ray showing bilateral diffuse infiltrates, which appear as cloudy, hazy opacities throughout both lung fields. The heart silhouette is visible in the center, and the rib cage is outlined. The overall appearance is consistent with interstitial lung disease or infection.

HOSPITAL X
LAST NAME: DOE
FIRST NAME: JANE

DIAGNOSTIC IMAGING REPORT

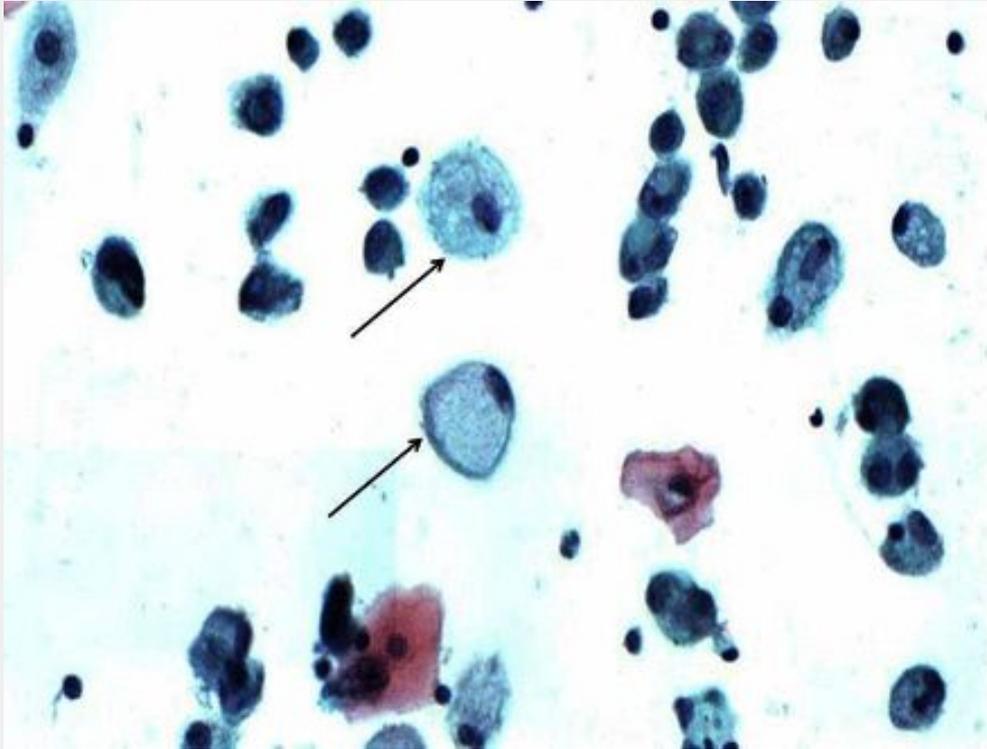
PROCEDURE: Chest X-Ray.

FINDINGS:

- Bilateral diffuse infiltrates (cloudy-looking matter)

IMPRESSION:

- Possible interstitial pneumonia, pulmonary vasculitis, or infection.



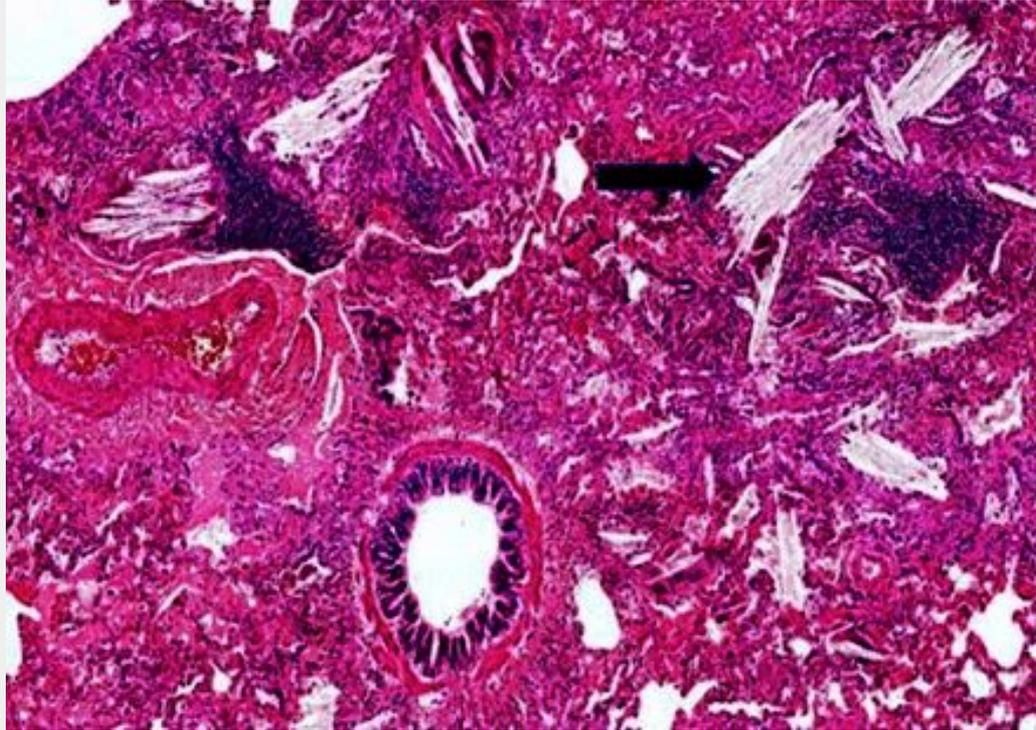
PROCEDURE: Bronchoalveolar lavage.

FINDINGS:

- Pink cloudy fluid, negative for infection
- Alveolar macrophages with foamy cytoplasm.

IMPRESSION:

- Lung biopsy recommended.



PROCEDURE:

Thoracoscopic surgical lung biopsy.

FINDINGS:

- Lipid-filled macrophages
- Cholesterol clefts
- Inflammation

IMPRESSION: Lipoid pneumonia.

Pathophysiology of Vaping and the Public Health Crisis

Presentation Outline

1. Introduction to the “Vaping Epidemic”
 - a. Rise in e-cigarette popularity
 - b. E-cigarette mechanism, ingredients of liquid
 - c. Prevalence and regulation
2. Physiological effects of vaping
 - a. Effects on respiratory function
 - b. Cellular effects on respiratory epithelia
 - c. Future studies



FTC orders e-cigarette companies to turn over marketing, advertising info

BY NATHANIEL WEIXEL · 10/03/19 01:00 PM EDT

4 COMMENTS



DAILY CALLER

President Trump's Vaping Ban, Explained

2 KUTV

NEWS

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Is there really a 'vaping health crisis?' What we know...

by ADAM FORGIE | KUTV Staff | Wednesday, October 2nd 2019

AA



Vaping in the News

World Canada Local Politics Money Health Entertainment

HEALTH

Vaping-related lung injury might not be caused by inhaled oils, researchers say

BY JULIE STEENHUYSEN · REUTERS

Posted October 3, 2019 7:51 am



TICKING TIME BOMB I was so relieved when my husband started vaping...but eight months later he was dead

Mark Ridley

2 Oct 2019, 21:40 | Updated: 3 Oct 2019, 6:21

The Rise of E-Cigarettes

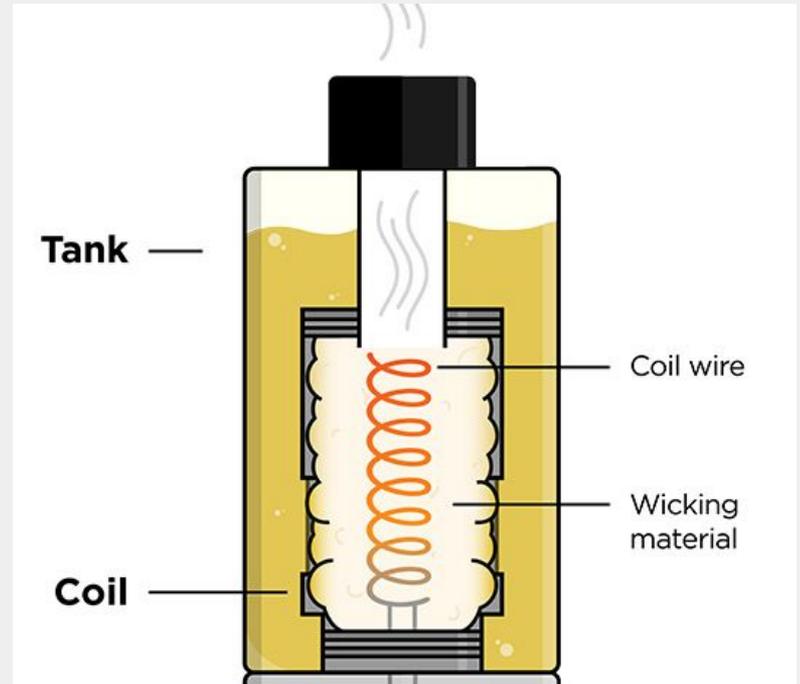
- Developed in China in 2003
- Introduced to American market in 2007
- Technically illegal in Canada until May 2018 but poorly enforced
- Intended for current smokers as a safer alternative to traditional cigarettes
- Major public health concern is use by non-smokers, particularly youth



How Do E-Cigarettes Work?

- E-liquid is heated and vaporized
- The components found in vapor are the same as those found in the liquid

- Compare to cigarette smoke, which contains over 7000 compounds formed by the combustion of tobacco



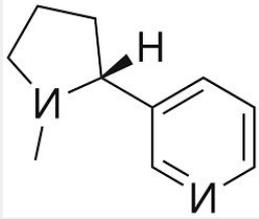
E-Liquid/ 'Vape Juice'



- 7000+ Flavours
- Ingredients:
 - Solvent (such as propylene glycol)
 - Flavouring compounds
 - +/- Nicotine
 - +/- THC

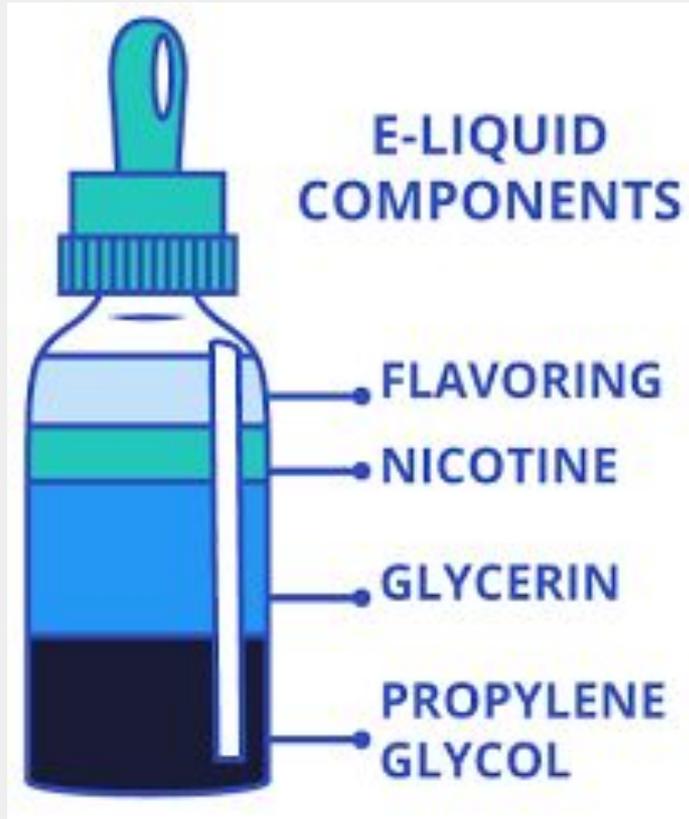


E-liquid Ingredients



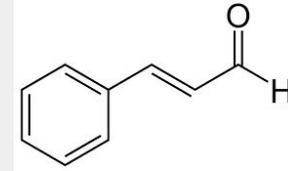
Nicotine

- Highly addictive
- ↑ efficiency nicotine delivery
- Withdrawal



Flavourings

- Poorly regulated
- Inhalation effects unknown
- Aldehyde flavours common



Propylene Glycol/ Vegetable Glycerin

- Oxidation at high temperatures → carbonyl compound formation
- Concentrations - E liquid and vape battery voltage dependent

Prevalence

- ~8% increase in report of vaping in Canadian youth ages 16-19 from 2017 to 2018
 - Similar statistic seen for smoking traditional cigarettes
- Same pattern seen when looking at teens who have never smoked
- Critics of these statistics say they do not take into account frequency of use in a given time period



Factors Affecting Prevalence

- Perception as “safe”
 - *Safer* than traditional cigarettes, but not safe on its own
- Youth-Specific Factors
 - Advertising
 - Emotional appeals (happiness, friendship, success)
 - Animation
 - Flavouring
 - Appeal to young people (cotton candy, popcorn, chocolate)
 - Design
 - Shaped like familiar objects (pens, USBs)



Government Regulation



Before May 2018

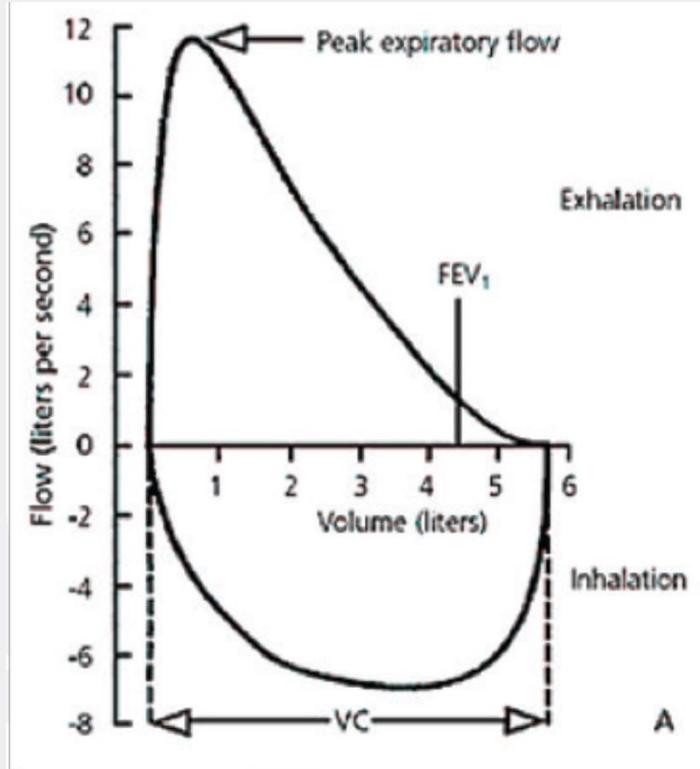
- Vaping products were considered illegal, unregulated drugs
- Ban was only enforced based on complaints received
- Upon receipt of a complaint, goods were seized at the border and/or notices to merchants were sent

After May 2018

- Sale of vaping products prohibited to those under 18
- Restrictions on advertising, packaging and flavours that may appeal to young people
- No legal limit on nicotine content

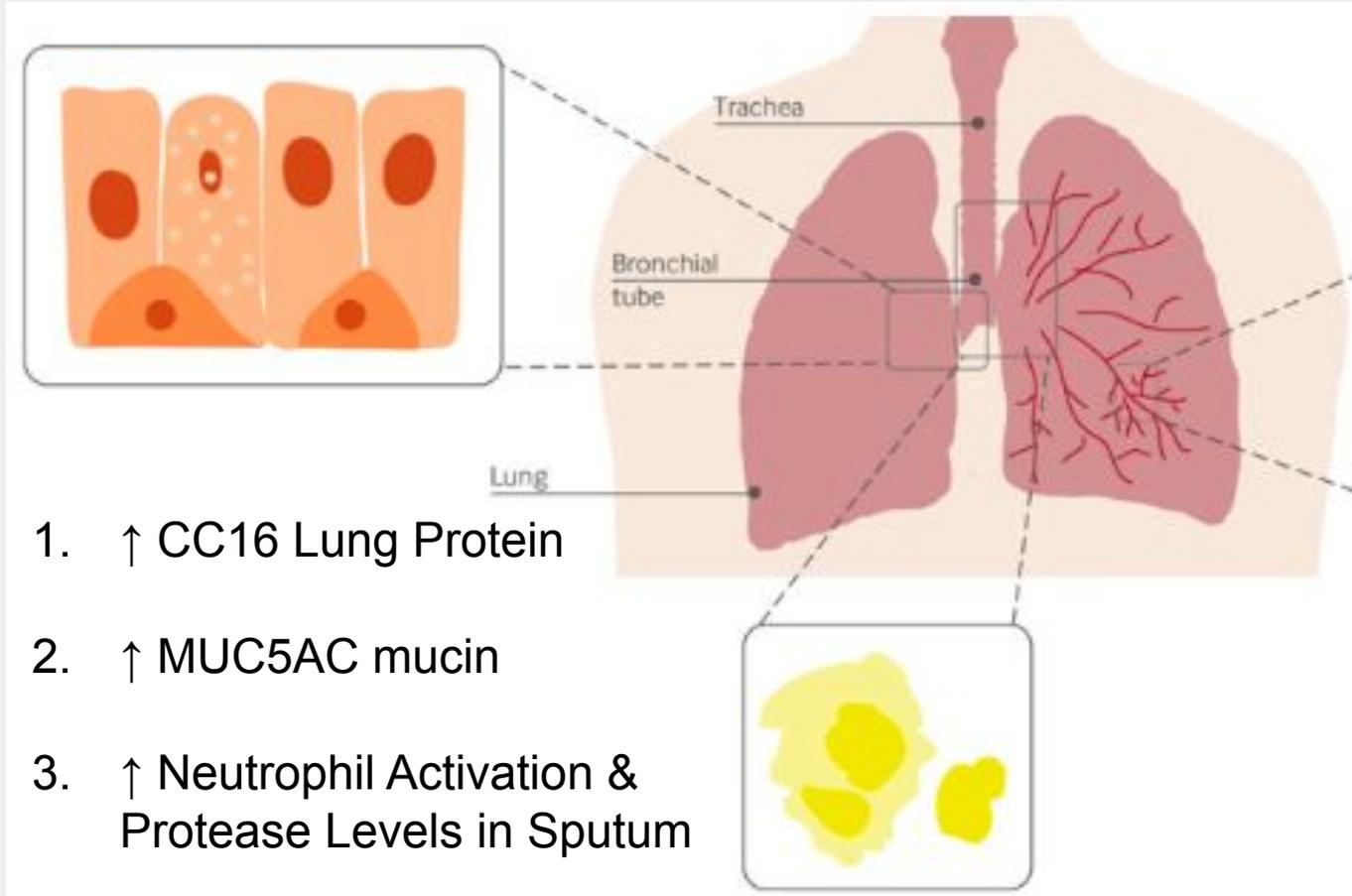


Airway Inflammation and Injury: Spirometry Assessments



- Acute vaping shows mixed results
- Few long-term use studies
 - \downarrow FEV₁ and FEV₁/FVC ratio
- \uparrow in airway resistance due \downarrow in diameter
 - smooth muscle contraction
 - bronchospasm
 - enhanced secretions

Airway Inflammation and Injury: Pathophysiology



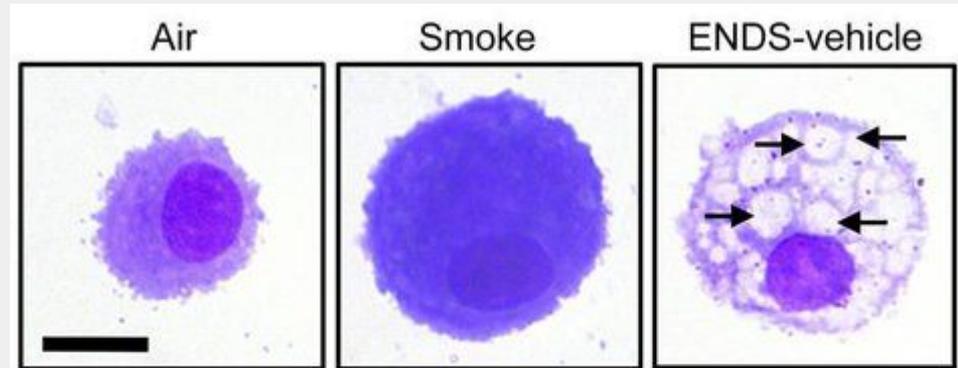
Alveolar Inflammation

Various studies on alveolar macrophages treated with e-cig vapour condensate:

- Dose-dependent ↓ alveolar macrophage viability
- ↑ IL8, IL6, TNF α , CXCL, MCP-1 release
- ↑ apoptosis, exaggerated in the presence of nicotine
- ↑ reactive oxygen species (ROS)

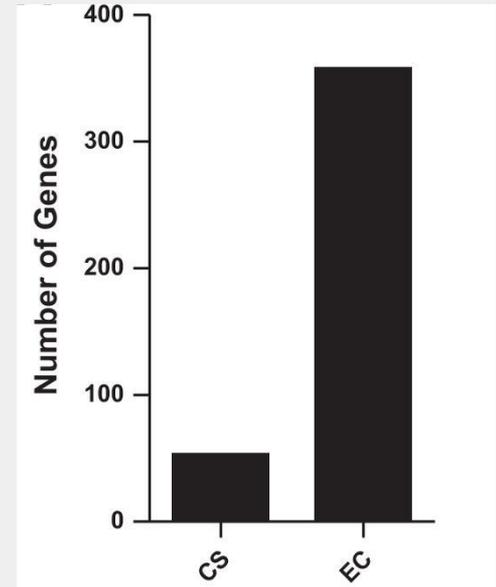
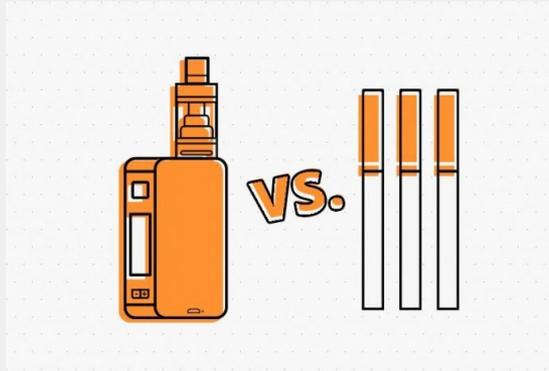
Mice study on alveolar macrophages

- Significant increase in lipids
- Impaired immune response to influenza



Future directions of e-cigarette studies

1. What exactly is responsible for vaping-associated lung injury?
2. Change in transcriptomic profiles of respiratory epithelia
 - Cause large change in gene expression in nasal epithelial cells, mostly associated with immune suppression, compared to cigarette-use
3. Long-term health risks
 - Cancer
 - Immunity



Presentation Summary

- Large increase in e-cigarette use among smokers and non-smokers since it first appeared on the market in 2003
- Current public health crisis, concerns with advertising use to youth and non-smokers
- Affects respiratory function including FEV₁, airway resistance
- Evidence of causing inflammation in airways and alveoli, and impairing alveolar macrophage-mediated immune response
- Require future studies investigating its effect on respiratory health and function, and potential long-term health effects.

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