

PainWeek[®]

Puff and Anarchy: Vape Technology and Its Consequences

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Disclosures

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Pain and Chemical Dependency

Hamilton, Ontario

CANADA

- Nothing to disclose

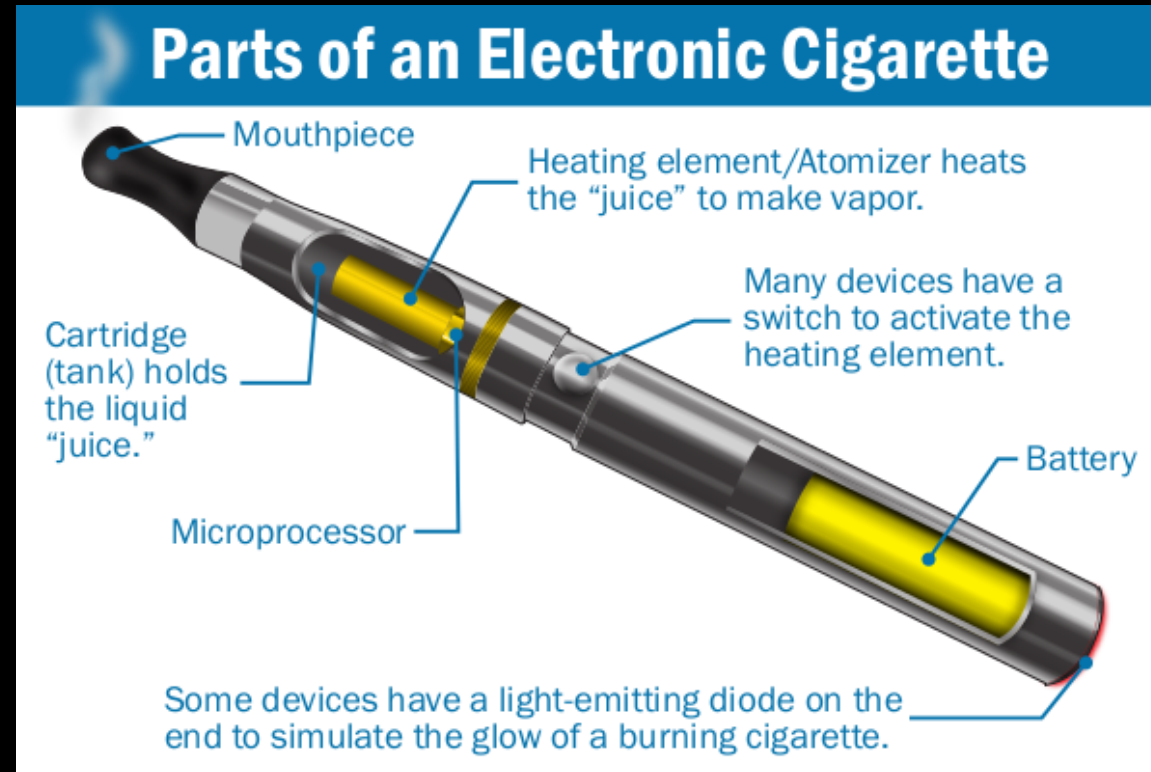
Learning Objectives

- Examine the underlying science behind vaping related to e-cigarette technology and its derivatives
- Discuss smoking cessation and e-cigs:
What was promised? What has been delivered?
- Review the “full spectrum CBD liquid” and the “Entourage Effect” of CBD and vaping

Elements in Common for e-cig System...

- Power supply – single use battery or rechargeable (~3.7 volts)
- Microprocessor control – detects demand; voltage of battery (and alert the user when the battery reaches a specified value)
- Storage compartment – either a simple wick or actual liquid reservoir
- Atomizer/vaporizer unit
- Drip tube and user mouth piece

Typical e-cigarette



https://en.wikipedia.org/wiki/Construction_of_electronic_cigarettes

Propylene Glycol and Vegetable Glycerin

- The Food and Drug Administration (FDA) has **classified propylene glycol** as an additive that is “generally recognized as **safe**” for use in food. ... It may exist in air in the vapor form, although **propylene glycol** must be heated or briskly shaken to produce a vapor. **Propylene glycol** is practically odorless and tasteless
- **Vegetable glycerin**
 - By-product of soap manufacturing
 - Common use in cosmetics
 - Generally considered safe in low concentrations – concerns emerging re pulmonary effects
- **But when heated, toxicity changes dramatically***

*Jensen R. Paul et al. Hidden Formaldehyde in E-Cigarette Aerosols. N Engl J Med. 372:4 Jan 22, 2015

So... Where Did the e-cigarette Come From?

- Herbert A Gilbert, a 2 ppd smoker patented a smokeless nontobacco cigarette in 1965... but it never caught on
 - But in 2003, Hon Lik in China developed and patented the “e-cigarette” to address the massive smoking problem in China*
 - Now, it’s a \$10 billion/yr worldwide industry
- Originally, the nicotine containing liquid was in free-base form**
 - “Big tobacco” has known for years this is not the most efficient way to deliver nicotine to the brain but through existing tobacco chemistry, the development of nicotine salts has become the norm
 - “better bang for the buck”
 - Higher nicotine concentrations delivered to the brain
 - Cheaper replacement “e-juice” for vapor systems

*<https://patents.google.com/patent/EP1618803A1/en?inventor=Lik+Hon&sort=old>

Barrington-Trimis, Jessica et al **Adolescents’ Use of “Pod Mod” E-Cigarettes – Urgent Concerns.
N Engl J Med 379; 12 2018

PG + VG (heat) = VAPOR

- Relative ratio of PG/VG determines quality of the ‘vapor’
 - Higher PG = thinner liquid, greater ‘smoke hit’ in throat
 - Higher VG = more viscous, greater volume of smoke
 - Other variables include temperature of the atomizer and quantity of liquid
 - ie, capillary action of original e-cig = limited vapor
 - “drip” delivery of PG/VG to heater element = huge volumes of smoke*
- What ever substances are present in the vape liquid will play a role in what is in the vapor (including PG/VG)
 - Diacetyl is a flavoring chemical: it and oxidation products appear in the vapor, ie, acetic acid
 - Pesticides (in far greater concentrations after concentrating)
 - Thermal decomposition of propylene glycol and flavoring agents create toxic aldehydes**

*Suchitra Krishnan-Sarin et al **E-Cigarettes and “Dripping” among High-School Youth**, Pediatrics 2017: 139(3)

** Andrey Khlystov and Vera Samburova **Flavoring Compounds Dominate Toxic Aldehyde Production during E-Cigarette Vaping**. Environ. Sc. Technol. 2016. 50. 13080-13085

In a Perfect World....

- Vaping would involve taking pure compounds of vehicle (PG/VG) and active ingredient (nicotine/THC/CBD, etc) in precise concentrations, applied to a heating element held to exacting standards to deliver ONLY the desired elements of the mixture

BUT...

- In reality.... The starting materials are not pure and typically contain >1 flavoring agents, the proportions may/may not be clearly defined and, as a result of a number of variables, the compound(s) delivered may contain trace heavy metals, undesired oxidation products of both known and unknown toxicity, and device modifications that are impossible to control

Smoking Cessation

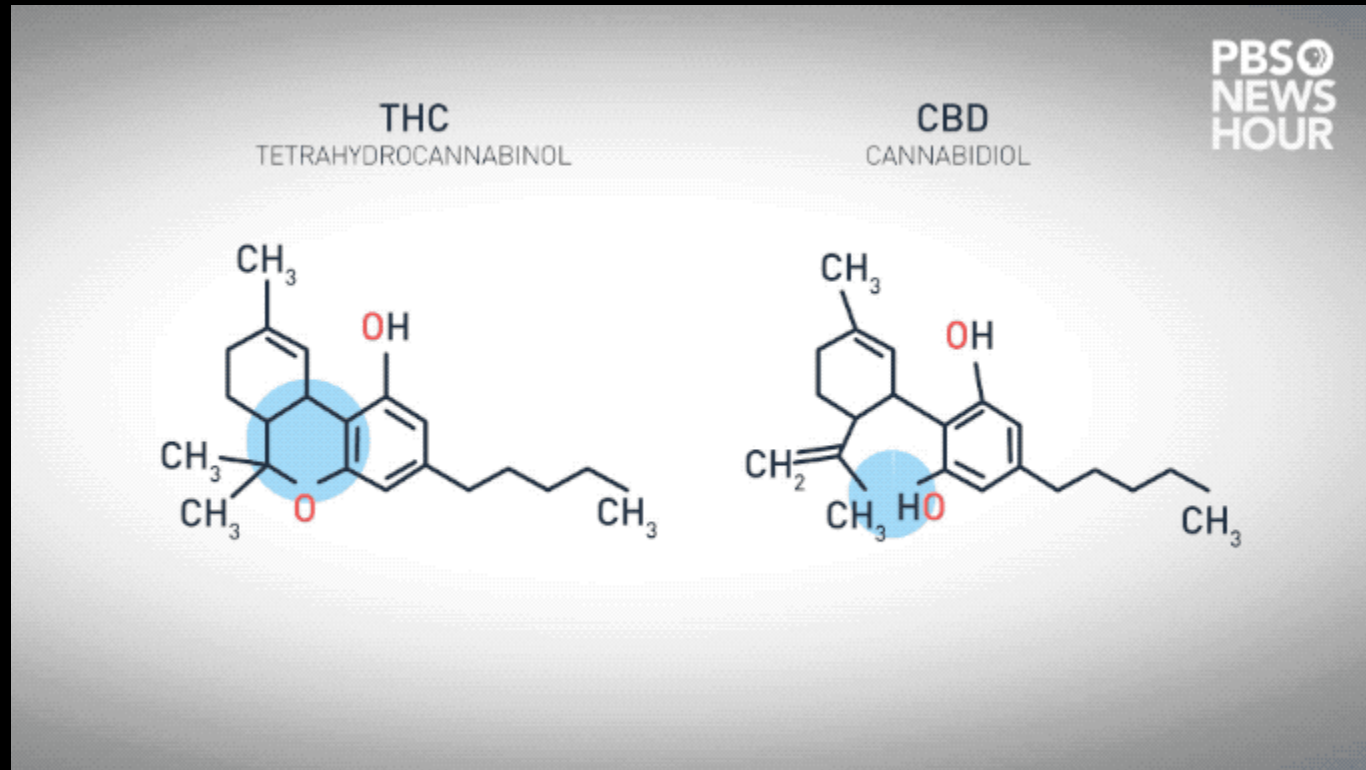
- In Canada, e-cigarette use is increasing, specially among youth*
 - Use in Canadians age 16-17 increased from 29.3% in 2017 to 37% in 2018
 - Moreover, prevalence and frequency of vaping increased among never and experimental smokers in parallel with market rise of higher nicotine concentration delivery systems
 - E-cigarette use is strongly associated with initiation & ongoing use of cigarette smoking
 - 14-30 year old nonsmokers who use e-cigarettes have a >3 fold increased risk (23.2% vs 7.2%) of initiation of cigarette smoking (1 in 6)
 - E-cigarettes are an additional smoking cessation tool
 - Randomized clinical trial (Hajek P, et al. Randomized trial of e-cigarettes vs nicotine–replacement)
 - E-cigarettes are unregulated products with potentially dangerous health effects
 - Clinicians should ask every patient about e-cigarette use

*Aloosh Mehdi et al **E-Cigarettes** CMAJ 2019 Oct 15;191:E1136

Cannabinoid Delivery Systems

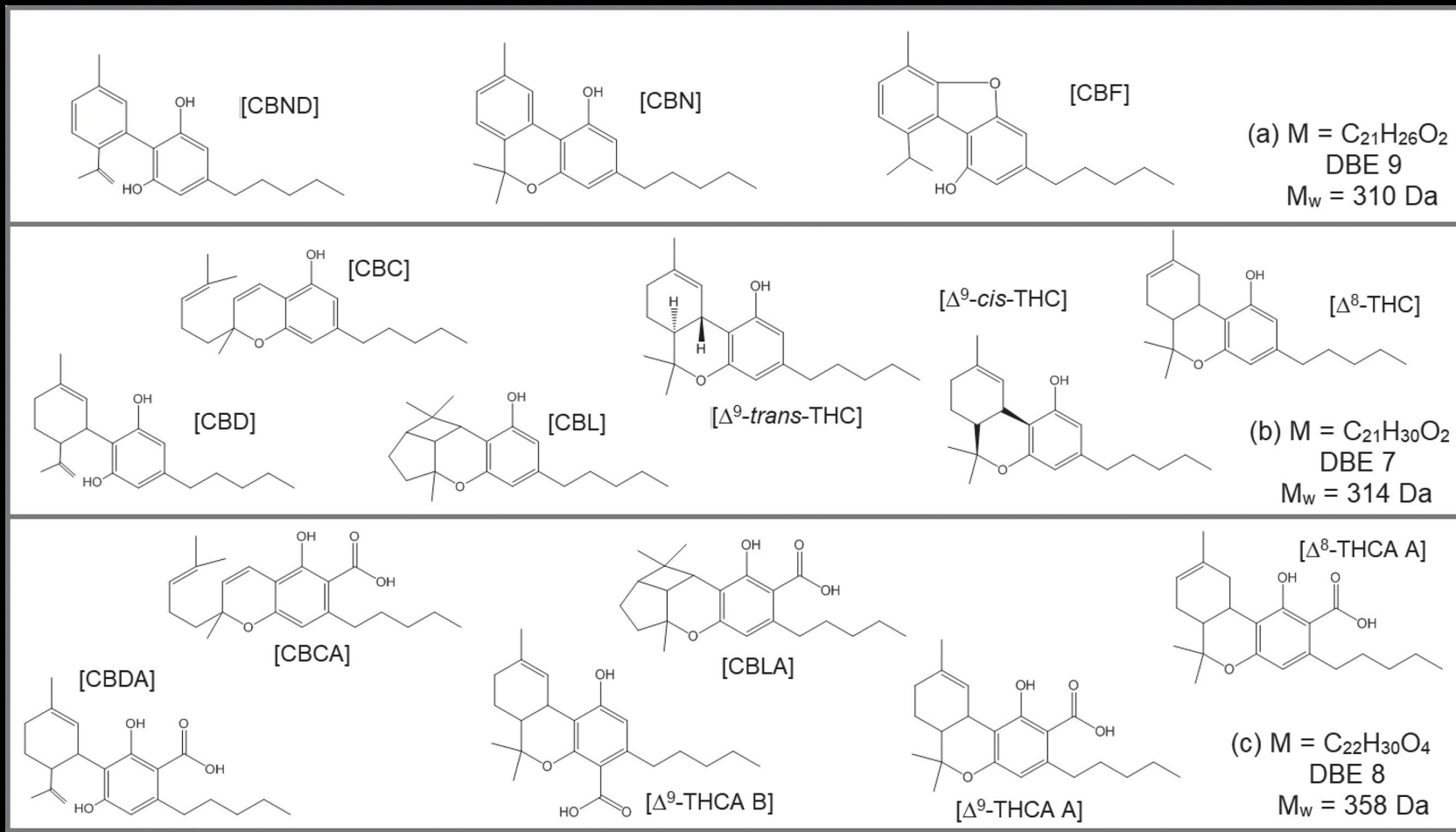
- The recent state legalization of medical marijuana and, in some cases, recreational marijuana has resulted in the search for “safer” and more efficient drug delivery systems
 - Many thought of vaping as a “less harmful” way to use cannabis – not true!
 - E-cig Vaping Associated Lung Injury (EVALI)
 - Evidence on medical effectiveness is unclear
 - Even use of CBD in pediatric epilepsy is coming into question
 - Mounting evidence of significant risk intrinsic to the vaping process
 - (bronchiectasis obliterans, ie pop corn lung)
 - Flavoring agents causing harm
 - Insecticides etc

The Active Ingredients – but there are many more



<https://www.analyticalcannabis.com/articles/cbd-vs-thc-what-are-the-main-differences-297486>

















Other Cannabinoids



Some Other Noncannabinoids

TERPENES IN CBD OIL

THERE ARE MORE THAN 100 TERPENES IN JUST ONE CANNABIS FLOWER. HERE ARE SOME OF THE MOST WELL KNOWN TERPENES RIGHT NOW, MOST OF WHICH YOU'LL FIND IN LEGAL CANNABIS PRODUCTS IN YOUR AREA.

 <p>Bisabolol <i>floral</i> Properties anti-inflammatory anti-irritant anti-microbial Common Uses cancer, skin lesion</p>	 <p>Borneol <i>mint</i> Properties anti-inflammatory antinociceptive Common Uses eyesight, pain relief</p>	 <p>Camphene <i>fir needles, musky earth</i> Properties anti-oxidant skin lesion Common Uses cardiovascular diseases</p>	 <p>Caryophyllene <i>spicy</i> Properties anti-bacterial anti-inflammatory anti-fungal Common Uses insomnia, muscle spasms pain relief</p>	 <p>Delta 3 Carene <i>pine, rosemary</i> Properties anti-inflammatory bone stimulant Common Uses memory</p>	 <p>Eucalyptol <i>mint</i> Properties anti-bacterial anti-fungal Common Uses alzheimer's pain Relief</p>	 <p>Geraniol <i>peach, rose grass</i> Properties anti-cancer anti-oxidant neuroprotectant Common Uses cancer, pain relief</p>	 <p>Humulene <i>earthy</i> Properties anti-bacterial anti-inflammatory anti-tumor effects Common Uses cancer, infections appetite suppression</p>
 <p>Limonene <i>bitter citrus</i> Properties anti-anxiety anti-cancer digestion, gallstones Common Uses liver detoxification weight loss, sleep aid</p>	 <p>Linalool <i>floral</i> Properties anti-anxiety anti-epileptic anti-psychotic pain killing Common Uses depression, convulsions insomnia, pain relief</p>	 <p>Myrcene <i>citrus, cloves</i> Properties relaxing sedating Common Uses inflammation, insomnia spasms, pain</p>	 <p>Pinene <i>pine</i> Properties anti-depressant anti-inflammatory anti-microbial Common Uses asthma, bronchitis cancer, depression memory, mental alertness</p>	 <p>Phytol <i>balsamic, floral</i> Properties anti-insomnia immunosuppressant Common Uses reduce itching sleep aid wound healing</p>	 <p>Terpinolene <i>smoky, woody</i> Properties anti-bacterial anti-fungal anti-insomnia antiseptic Common Uses cancer heart disease sleep aid</p>	 <p>Trans-nerolidol <i>citrus, rose</i> Properties anti-cancer anti-microbial anti-oxidant, anti-parasitic Common Uses relaxing skin lesion</p>	 <p>Valencene <i>sweet citrus</i> Properties anti-inflammatory anti-melanogenesis antiallergic Common Uses memory skin lesion</p>

In Reality...

- The vaping industry has been largely uncontrolled
 - Since 2016, regulations introduced limiting access to e-cigs by age have pushed e-cigarette user to turn to traditional cigarettes
- Flavoring agents – agents and drug concentrations remain unregulated: flavorings are clearly targeting youth
- Equipment – rebuildable/modifiable atomizers
- Alternative methods of use:
 - Dripping – direct contact of “juice” with heating element = huge volumes of vapor
 - Use of nicotine salts in refillable e-cigs designed for nonsalt based juices
 - Results in much higher pulmonary nicotine delivery so possible nicotine toxicity

Counterfeit e-Liquids and Pods

- CBD and THC oils are viscous: “the thicker the liquid, the higher the concentration”
 - UNLESS it has been adulterated or “diluted” with a cheaper material with similar viscosity to cannabis oils, ie, “vitamin E oil”*
 - Why do it? MONEY!
- The replacement pods are all available from the manufacturers in China – regardless of brand name

*Boudi F, Patel S, Boudi A, et al. (December 11, 2019) Vitamin E Acetate as a Plausible Cause of Acute Vaping-related Illness. *Cureus* 11(12): e6350. DOI 10.7759/cureus.6350

Is It Pure or Adulterated: CBD and THC?

Regulatory Framework – A Real Mess

- Cannabis and ALL compounds derived therefrom are ILLEGAL
 - Schedule 1 at the federal level
- Hemp is ‘cannabis’ containing less than 0.3% THC by dry weight (legal)
 - CBD from ‘hemp’ is legal (Hemp Farm Bill 2018*)
- Cannabis containing more than 0.3% THC is marijuana (illegal)
 - CBD from marijuana – still illegal
- Cannabis or any of its products cannot cross international borders
 - (even if the product is legal in both countries ie CBD products can’t cross from USA to Canada - USA)

*<https://www.fda.gov/news-events/congressional-testimony/hemp-production-and-2018-farm-bill-07252019>

So, What is the Message to Your Patients?

- If you don't smoke: DON'T START (including e-cigs)
 - If you are a smoker, get professional, knowledgeable help to quit
- If you chose vaping as a delivery system – for nicotine, CBD, or THC – make sure you are aware of the risks
 - Stay away from the net – the Wild West is not the place to trust your health to
 - Find a local vendor you can trust and get to know them
 - Cheapest isn't always the way to go, especially if you factor in a double lung transplant into the equation
- Avoid flavored “juices.” The flavoring agents may be more dangerous than the active ingredients

Conclusions

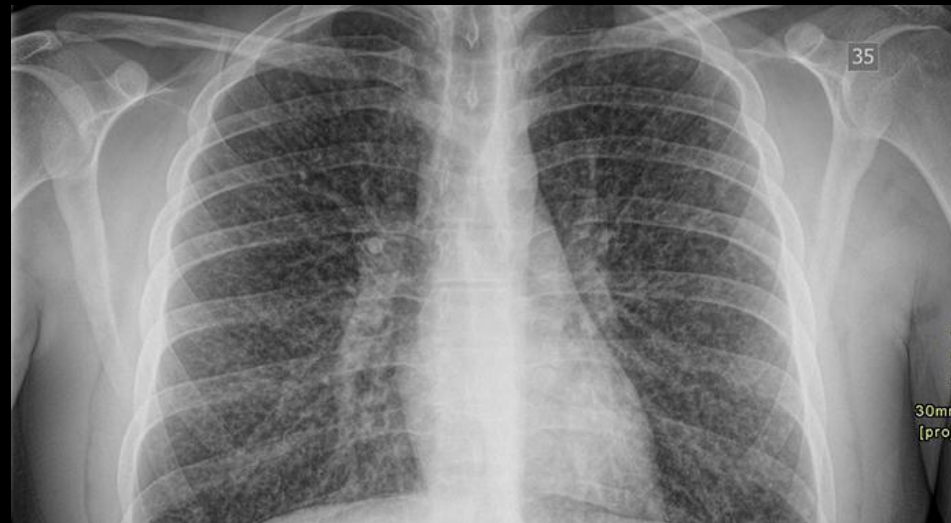
- The use of e-cigarettes to quit smoking may be jumping from the frying pan into the fire
- At the present time, much of the advertising and the large internet presence are being dedicated toward the youth market potentially making this method of use even more dangerous
- The relatively unregulated nature of this industry is likely to become more heavily regulated, over time – children and adolescent use will likely move to traditional tobacco containing products.

Question 1

- A 19 year old, previously well college student became acutely short of breath. On arrival to the ER, he was tachycardic with a shallow pattern of breathing (RR 28) with decreased breath sounds. He is afebrile and in obvious distress.
- He is immediately placed on 100% oxygen mask
- Anesthesia and Respiratory Technology were called for probable intubation
- A chest x-ray was ordered:

Question 1 cont.

- Pre-intubation x-ray



Question 1 cont

- His oxygen saturation rose to 90% on 100% oxygen

The parents volunteered he had recently began using e-Cigarettes to help stop smoking (~ 6 months)

- The most likely cause of his respiratory condition is:
 - 1) acute bronchial pneumonia
 - 2) **acute bronchiolitis**– so called “pop corn lung” - ? d/t history of vaping
 - 3) Chronic Obstructive Pulmonary Disease due to smoking
 - 4) aspiration pneumonitis

Question 2

- The use of vape technology has been shown to be safer than smoking
 - True
 - **False**

- Question 3

- The “entourage effect” includes all of the following EXCEPT:
 - 1) the tendency cannabis users to use in groups
 - 2) suggests that the therapeutic effects of cannabis is a function of many plant constituents, not simply THC or CBD
 - 3) is not widely accepted in the scientific community
 - 4) May help explain why purer compounds tend to have less therapeutic effective

References:

- Contact:
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 - dgourlay@cogeco.ca
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