Dartmouth Health

Project ECHO

MCD Global Health

WELCOME to

Hooked on a Cloud: Youth Vaping Products, Risks, and Intervention Opportunities ECHO

Session 1, Vaping 101: What vapes are today, what they look like, and what's inside
September 24, 2025

Funding Statement

This program is supported by the Health Resources and Services Administration (HRSA) of the U.S. Department of Health and Human Services (HHS) as part of a financial assistance award totaling $474,667 annually with 100% funded by HRSA/HHS under award number UU7TH54328-01-00. The contents are those of the author(s) and do not necessarily represent the official views of, nor an endorsement, by HRSA/HHS, or the U.S. Government.

Series Learning Objectives

1. Explain the prevalence, basic physiology, pharmacology and health effects of nicotine vaping, including evidence-based interventions for vaping cessation and harm reduction.
2. Communicate comfortably and effectively with youth about vaping in order to engage them in reflection on use and movement towards elimination.
3. Advocate for policies at Federal, State and local levels aimed at reducing youth engagement in vaping.

Series Sessions

Date	Session Title
9/24/2025	Vaping 101: What vapes are today, what they look like, and what's inside
10/8/2025	Vaping 101: Physiology and health effects
10/22/2025	Interventions for vaping: Behavioral health strategies and medications
11/5/2025	Interventions for vaping: Apps, websites, and other self-guided strategies
11/19/2025	Strategies to engage youth and young adults in conversations about vaping
12/3/2025	Vaping influences: Industry, peers and policy

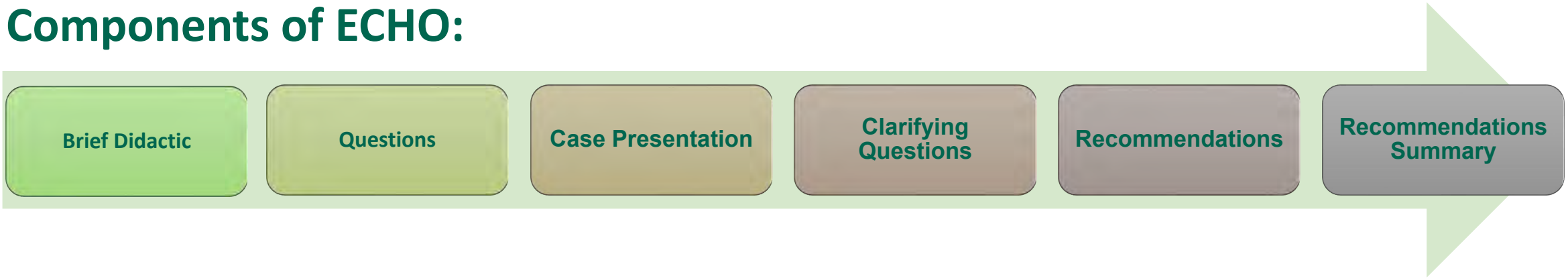
Today's Program

- Brief housekeeping
- Didactic: Vaping 101: What vapes are today, what they look like, and what's inside
  - Hilary Schuler, Maggie Coleman
- Case Presentation:
- Discussion
- Summary
- Up Next

Project ECHO (Extension for Community Healthcare Outcomes)

- All teach, all learn.
- ECHO is a telementoring model that uses virtual technology to support case-based learning and to engage the wisdom and experience of all attending.
- Highly Interactive.

Components of ECHO:



Notes

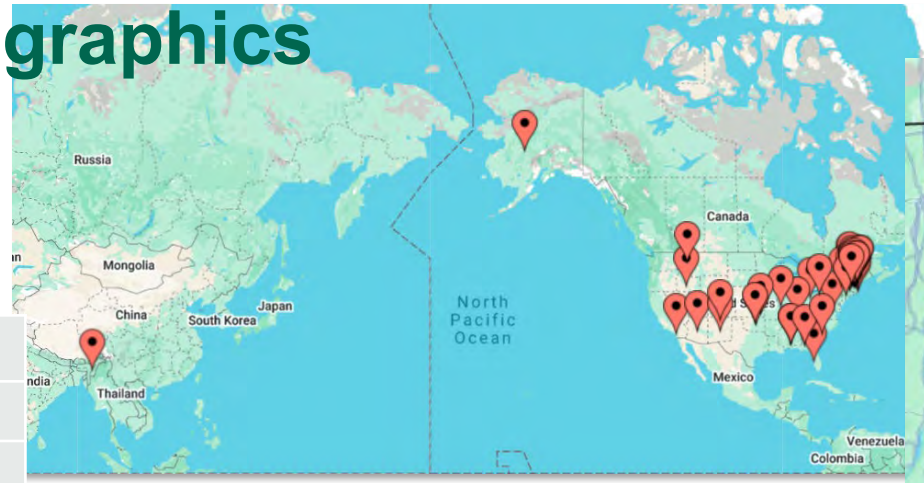
- Raise virtual hand or enter comments in chat at any time. We will call on you when it works. Please mute otherwise.
- To protect individual privacy, please use non-identifying information when discussing cases.
- We will be recording the didactic part of these sessions. *Participating in these session is understood as consent to be recorded. Thank you!*
- Closed Captioning will be enabled during sessions
- Questions to ECHO Tech Support thru personal CHAT or ECHO@hitchcock.org

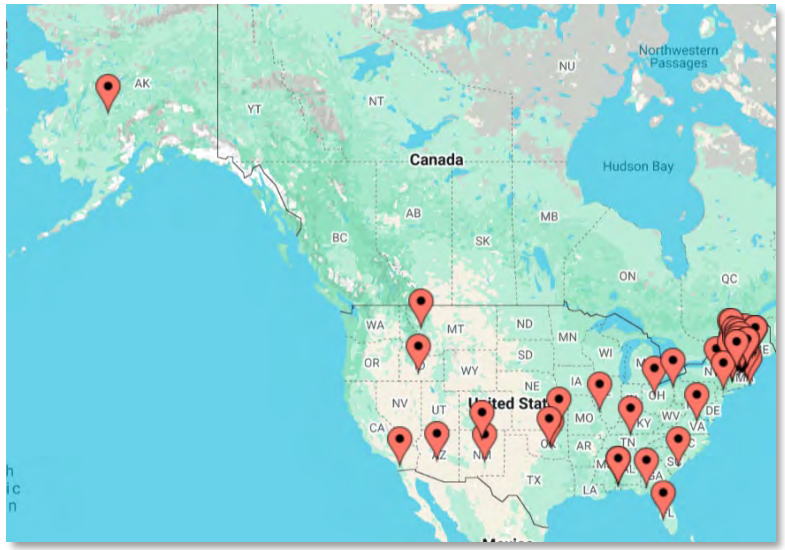
CME/CNE

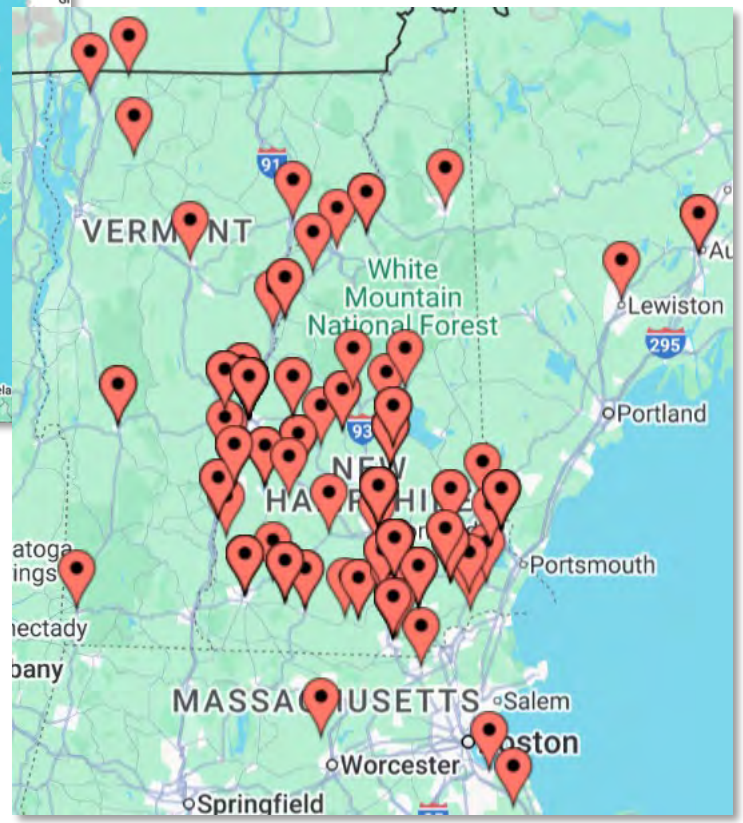
- One hour of free CME/CNE is available for every session attended, up to 6 sessions.
- Track participation via DH iECHO site
- A link will be provided at the end of the course to submit your attendance and claim your CME/CNE
- No relationships to disclose among planners, panel, speakers

ECHO Participant Demographics
Total Registrants: 183

Professional Identities	
Nurses	58
School Administration and Teachers	38
Behavioral Health Professionals	26
Administration	24
Other Healthcare	10
Physicians	3
Other	22







Core Panel

Alex Fannin, MS, APRN	Tobacco Treatment Specialist, Dartmouth Health
Brenna Morgan	Youth Voice and ECHO Facilitator
Caroline Christie, LICSW	Clinical Social Worker, Dartmouth Health
Hilary Schuler	Population Health Coordinator, Dartmouth Health
Maggie Coleman	Population Health Coordinator, Dartmouth Health
Sue Tanski, MD, MPH	Pediatrician, Dartmouth Health

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Vaping 101: What vapes are today, what they look like, and what's inside

Hilary Schuler
Senior Population Health Coordinator, DHMC

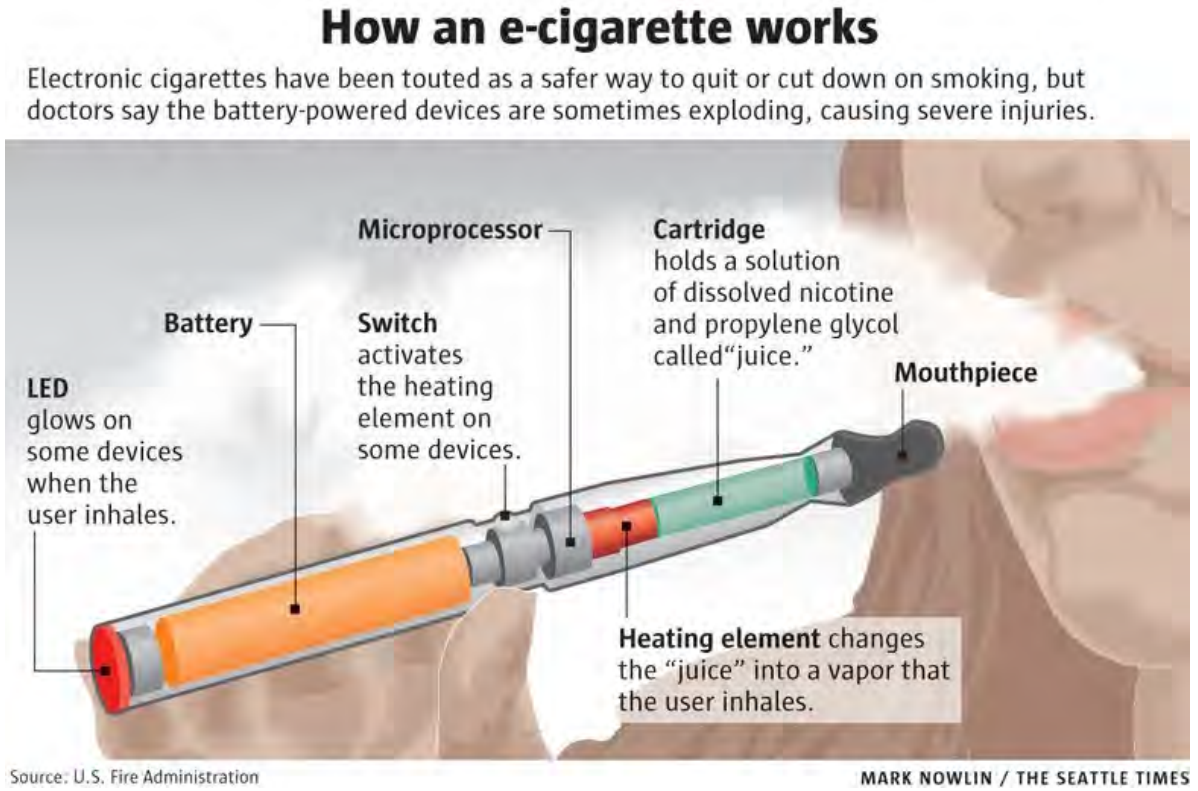
Maggie Coleman, MPH
Senior Population Health Coordinator, DHMC

Agenda

- Vaping 101
  - What is a vape?
  - What do vapes look like in 2025?
  - What's inside?
- Case discussion

What is a vape?

- “Vapes” or “e-cigs,” are electronic devices that heat liquid and produce an aerosol that is inhaled into the lungs.
- They contain a battery, a heating element, and a place to hold a liquid.
- The liquid or “e-juice” in vapes often contains nicotine, chemicals that help produce the aerosol, and artificial flavorings.
- People who use vapes breathe and exhale the aerosol produced when the vape heats this liquid.



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What do vapes look like nowadays?

ELF BAR
(36.1%)

BREEZE
(19.9%)

MR. FOG
(15.8%)

VUSE
(13.7%)

JUUL
(12.6%)

Source: [Dartmouth Health Vaping Education and Resources Toolkit]

Using a vape

- Vapes are small, easily tucked away, and both subtle and quick to use: the aerosol they produce disappears rapidly after being exhaled into the air.
- Vaping devices can also be modified to look like everyday objects, making them easy to disguise.
- We're now also seeing gamification of vape use through Bluetooth enabled digital "pet" vapes.

source

source

source

Stanford MEDICINE
REACH Lab

CIGS IN AN E-CIG

TOBACCO PREVENTION TOOLKIT

1 Pack of Cigarettes
= ~22mg of Nicotine

~20
CIGARETTES

1 JUUL Pod
= ~41.3mg of Nicotine

~37
CIGARETTES

1 Flum Float
= ~400mg of Nicotine

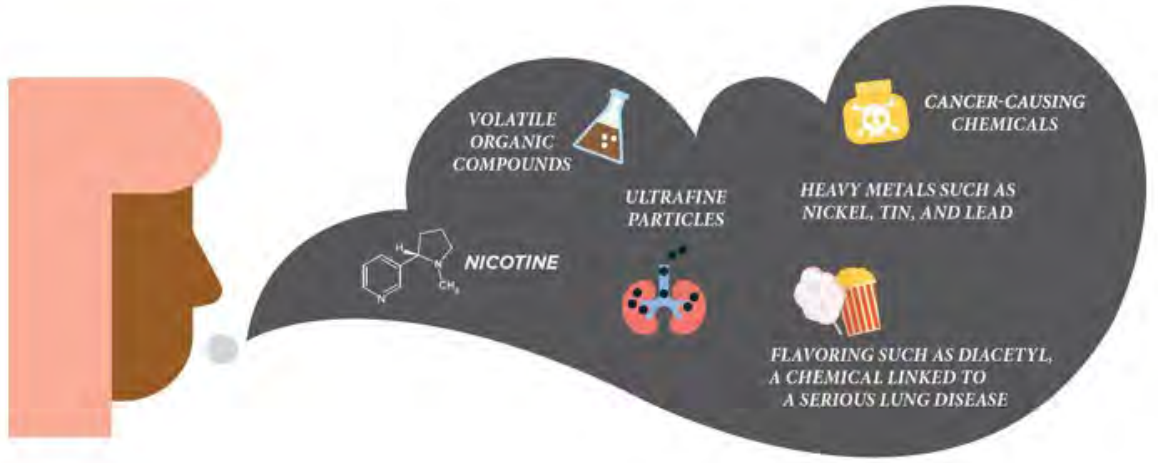
~363
CIGARETTES

1 Elf Bar
= ~650mg of Nicotine

~590
CIGARETTES

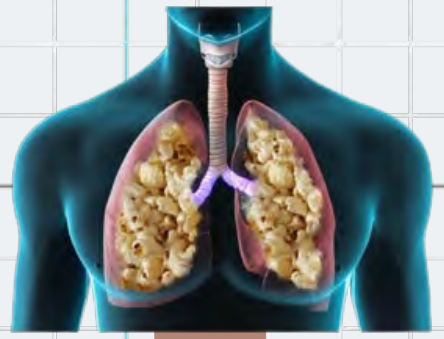
What else is inside?

- E-cigarette aerosol is ***NOT*** harmless “water vapor.”
- The e-cigarette aerosol that users breathe from the device and exhale can contain harmful and potentially harmful substances, including:
  - Nicotine
  - Ultrafine particles that can be inhaled deep into the lungs
  - Flavorings such as diacetyl, a chemical linked to a serious lung disease
  - Volatile organic compounds
  - Cancer-causing chemicals
  - Heavy metals such as nickel, tin, and lead1
- The aerosol that users inhale and exhale from e-cigarettes themselves and bystanders to harmful substances.
- Disposal/battery concerns



Source: CDC’s Quick Facts on the Risks of E-Cigarettes for Kids, Teens, and Young Adults

What's in that E-cig?



Diacetyl
(butter flavor)

Benzene
(gasoline)

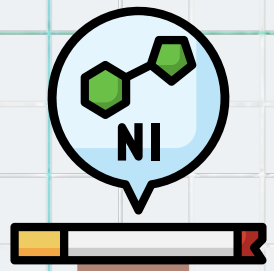
Cadmium
(batteries)

28
Ni
Nickel
58.693

Nickel
(cheap jewelry)

Lead
(car batteries)

Toluene
(paint thinner)



Nicotine
(tobacco)

N-Nitrosonornicotine
(pesticides)

Formaldehyde
(dead tissue preservative)

Key Resources

- DH Vaping Resource Folder and Youth Vaping Education and Resources Toolkit
- Stanford Medicine's Tobacco Prevention Toolkit
- My Life, My Quit (free and confidential cessation support for youth)

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Session 2, Vaping 101: Physiology and health effects

October 8, 2025

Vaping 101: Physiology and Health Effects

Susanne Tanski, MD MPH

Why do we care about vaping?

Nicotine Addiction, initiation of combustible tobacco use/dual use

Unknown Health Risks (too soon to know)

Lung harms (EVALI)

Exposes children, pregnant women, and non-users to secondhand aerosol

Diminishes the chances that a smoker will quit/ Discourages proven quit methods

Leads to relapse among former smokers

Environmental Waste

Results in poisonings among users or non-users

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"In a sense, the tobacco industry may be thought of as being a specialized, highly ritualized and stylized segment of the pharmaceutical industry. Tobacco products uniquely contain and deliver nicotine, a potent drug with a variety of physiological effects."

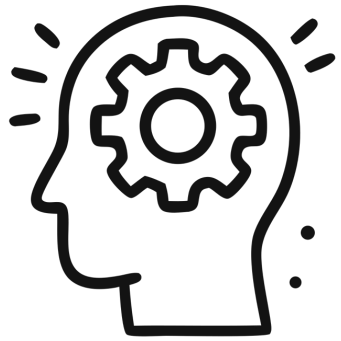
~Claude Teague Jr., Philip Morris, 1972

Similarly, vapes are providing a potent drug from an unregulated, unlicensed source that is only interested in profit…

Why Do People Use Tobacco? Nicotine is a psychotropic (drug that affects mental state) & makes users feel good.

Nicotine has complex impacts on the brain and body :

- Stimulant at low doses and a depressant at high doses



Stimulates memory and alertness.

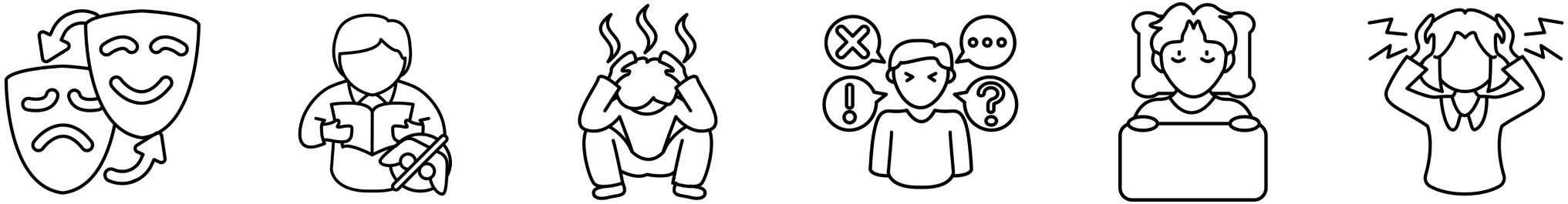
Many people feel a **sense of well-being.**

Decreases appetite.

Re-dosing prevents **withdrawal symptoms…**

Nicotine:
HIGHLY addictive, and abstinence leads to WITHDRAWAL:

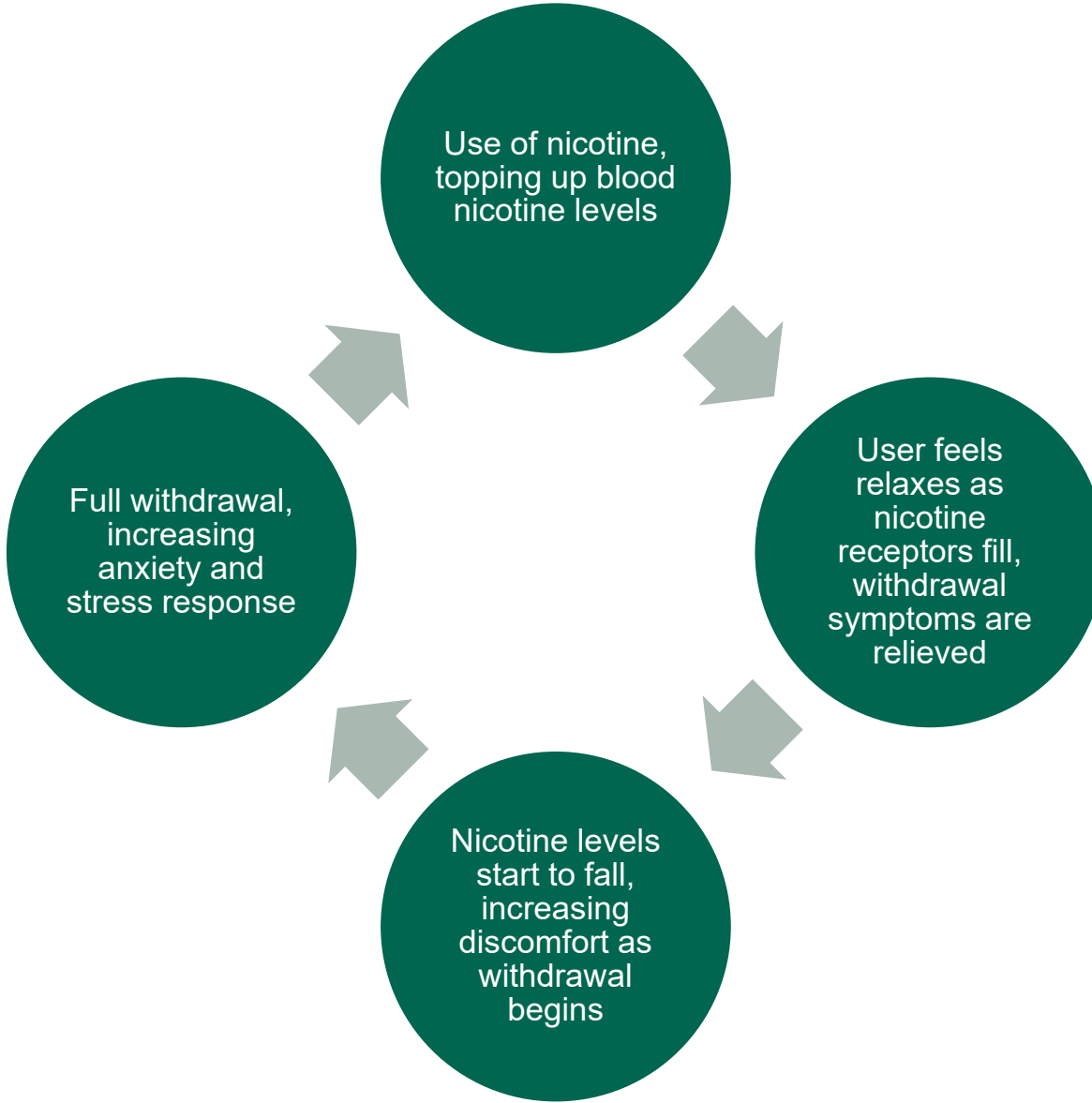
Irritability, frustration, anger, increased appetite, tremors, depression, insomnia, anxiety, difficulty concentrating



Business Insider Infographic, October 6, 2016

Stress and Nicotine: a behavioral reinforcer

- **STRESS** is the leading reason for relapse for all drugs.
- Nicotine users feel that use **REDUCES STRESS** because abstinence from nicotine **CAUSES** stress:
  - Nicotine + stress (cortisol) changes the the absorption of the drug (decreased bioavailability so need to use more) and the way it works (so it is more rewarding in times of stress).



Nicotine is *especially* addictive to youth, due to developmental stage, stress, social influence, etc.

Adolescents are developmentally primed for *drug use* and developmentally susceptible to *addiction*

- Why? Vulnerable time period due to brain development
  - Myelination, speeding up the highway
  - Synaptic pruning, trimming what isn't being used
  - Prefrontal cortex is not working (yet!)

Prefrontal cortex= "brakes"

Psychoactive Drugs

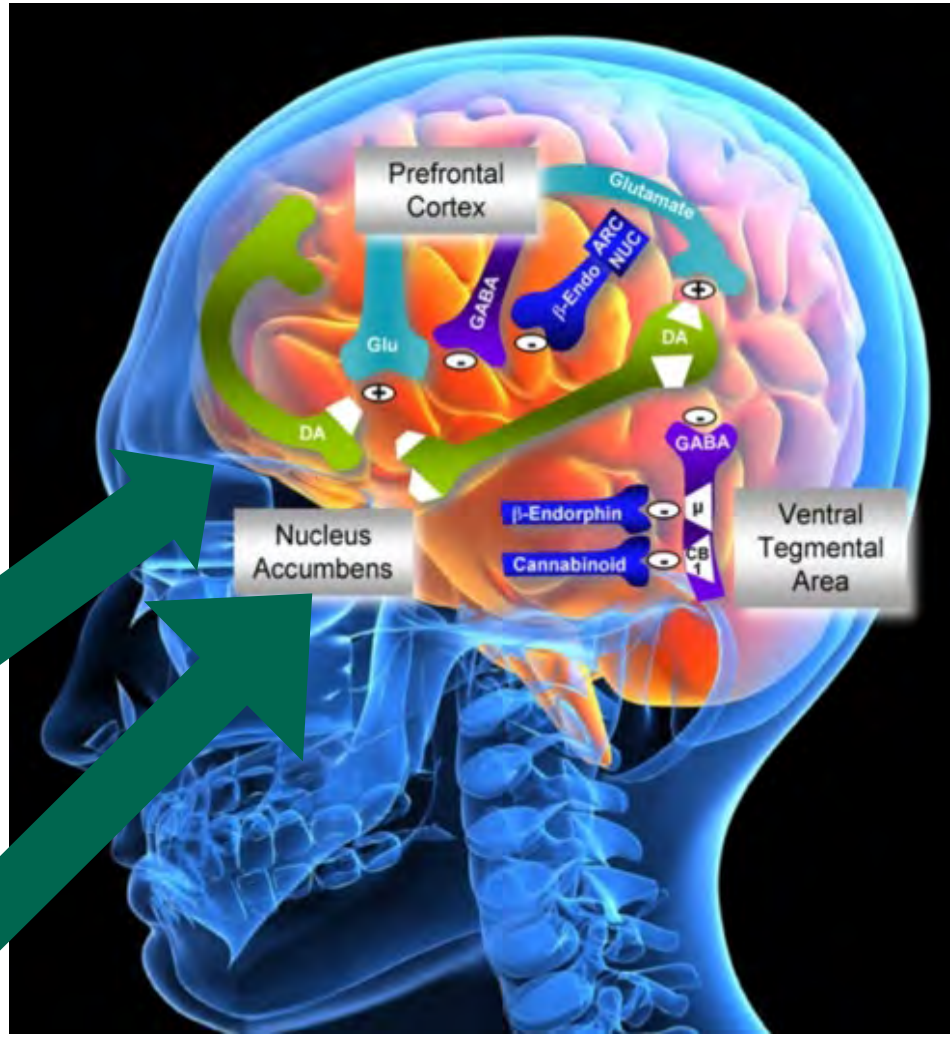
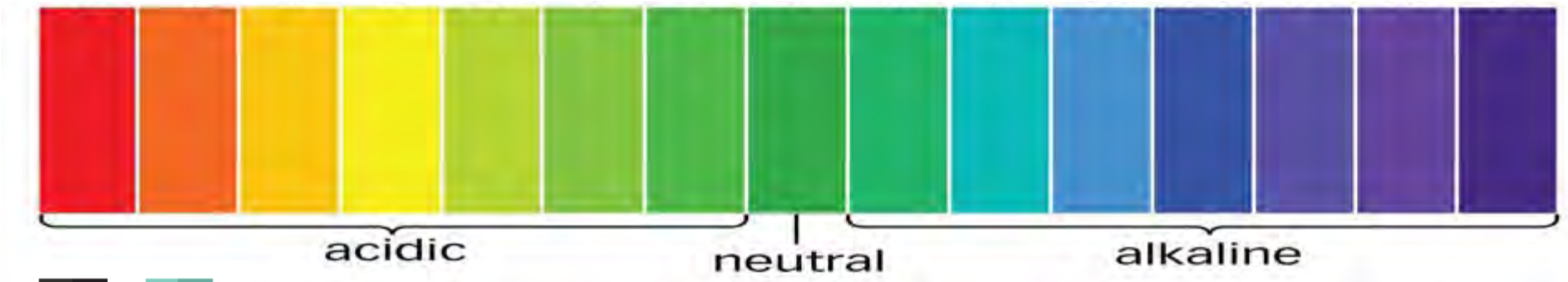


Image credit Professor Billy O'Connor, inside-the-brain.com

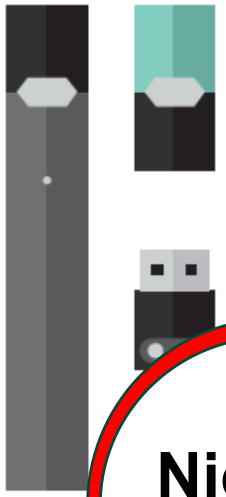
Delivery mode matters: lung is better than stomach, nose, mouth or skin

- The SPEED of drug delivery influences how rewarding it feels, and addiction potential
  - Blood delivers nicotine to the targets in brain and body
    - Nicotine can reach the blood through any surface
  - Lung surface area is about the size of a tennis court
  - Ultrafine particles can deliver nicotine deeper into the lung and cross from the lung to blood circulation faster

Chemistry matters too: JUUL figured out higher levels of nicotine to be inhaled more easily (without vomiting)



Nicotine delivered per pod/fill?? 20-90mg+++



Nicotine Salts

Benzoic Acid

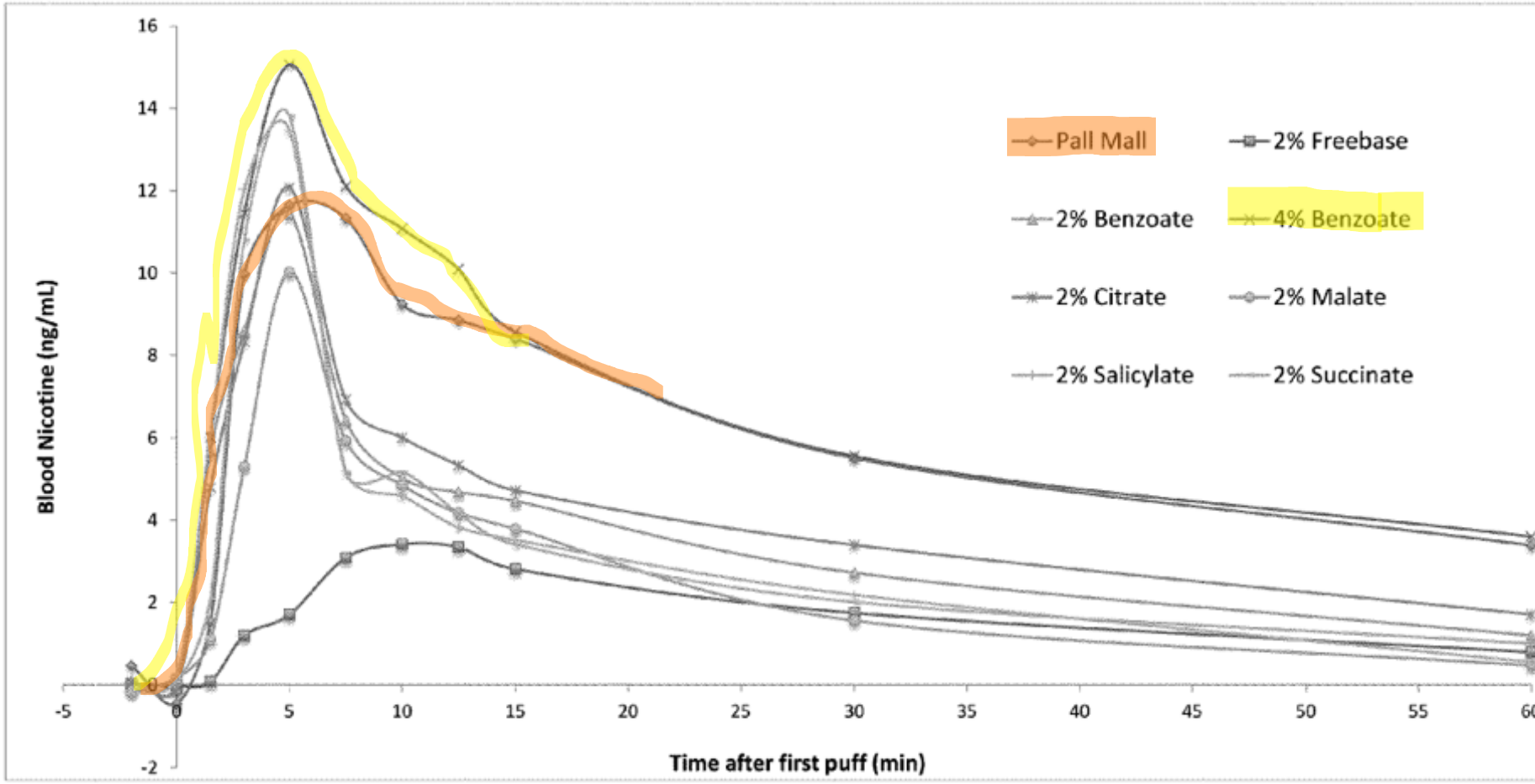
Free Base Nicotine

Nicotine *delivered* per cigarette ~0.7-1mg

Mimics Nicotine Delivery of a Combusted Cigarette

- Using the nicotine salt 4% benzoic acid enables much higher concentrations of nicotine – 5%

  – (56mg/mL)
- Improves the absorption to better simulate a cigarette



Bowen and Xing, US Patent 9,215,895
Juul Website, 2016

Nicotine Delivery of Cigarettes vs. Vaping Devices

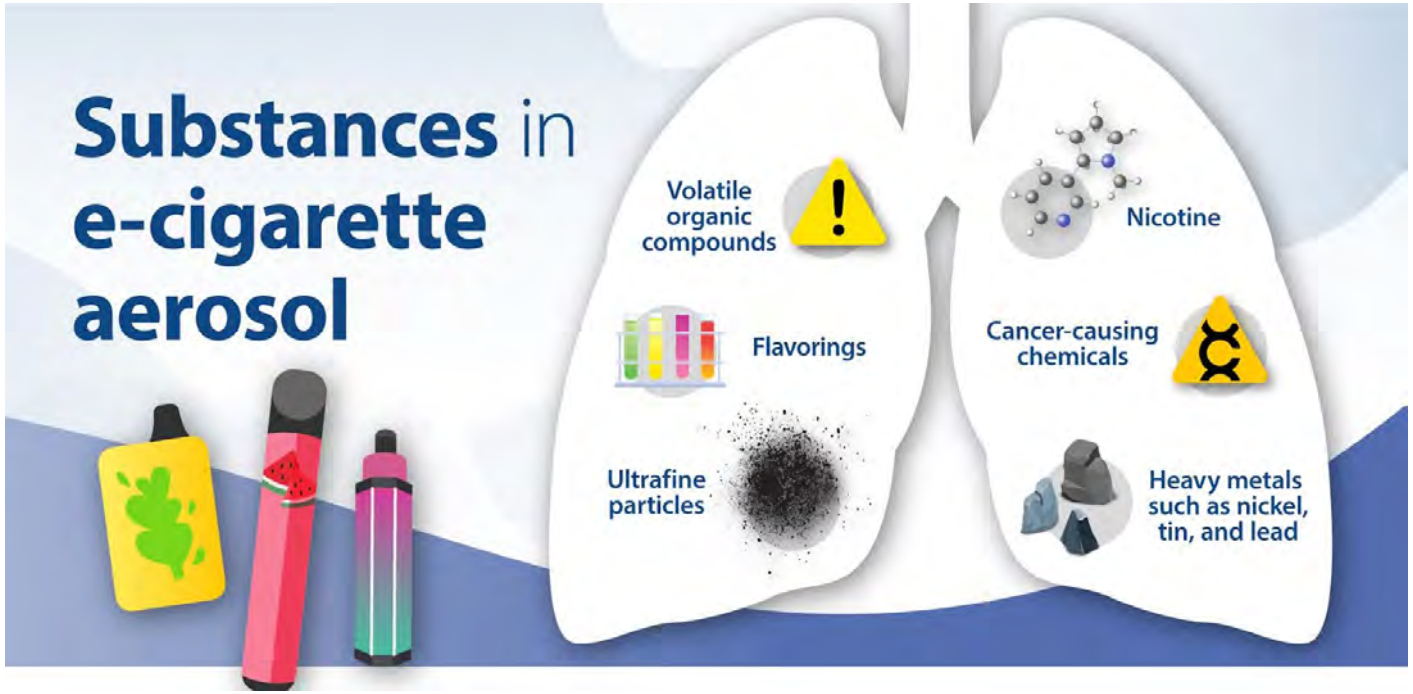
tobaccopreventiontoolkit.stanford.edu

TOBACCO PREVENTION TOOLKIT

1 Pack of Cigarettes ≈20 mg of nicotine	1 JUUL pod, 6% 0.7mL ≈42 mg of nicotine ? 20mg delivered	1 Suorin Air Plus pod, 3.5 mL 5x more than Juul	1 Hyde Rechargeable disposable, 7 mL 10x more than Juul	1 Mega Crave Rechargeable disposable “5500”, 12 mL 17x more than Juul	1 Elfbar Ice King Rechargeable disposable “30000”, 30 mL 28x more than Juul
					
20 CIGARETTES	**≈20?** CIGARETTES	**≈100?** CIGARETTES	**≈200?** CIGARETTES (that’s a carton…)	**≈340?** CIGARETTES (17 packs)	**≈560?** CIGARETTES (that’s a LOT…)
					

There are additional chemicals DELIVERED by e-cigarettes/vapes, many from the delivery system itself

- Humectant
- Flavoring
- +/- Nicotine
- Toxicants
- Carcinogens
- Metallic nano-particles (from the coil/heating element)
    - Other psychoactive ingredients (can also added by users)
    - Other medications: Melatonin? Essential oils?

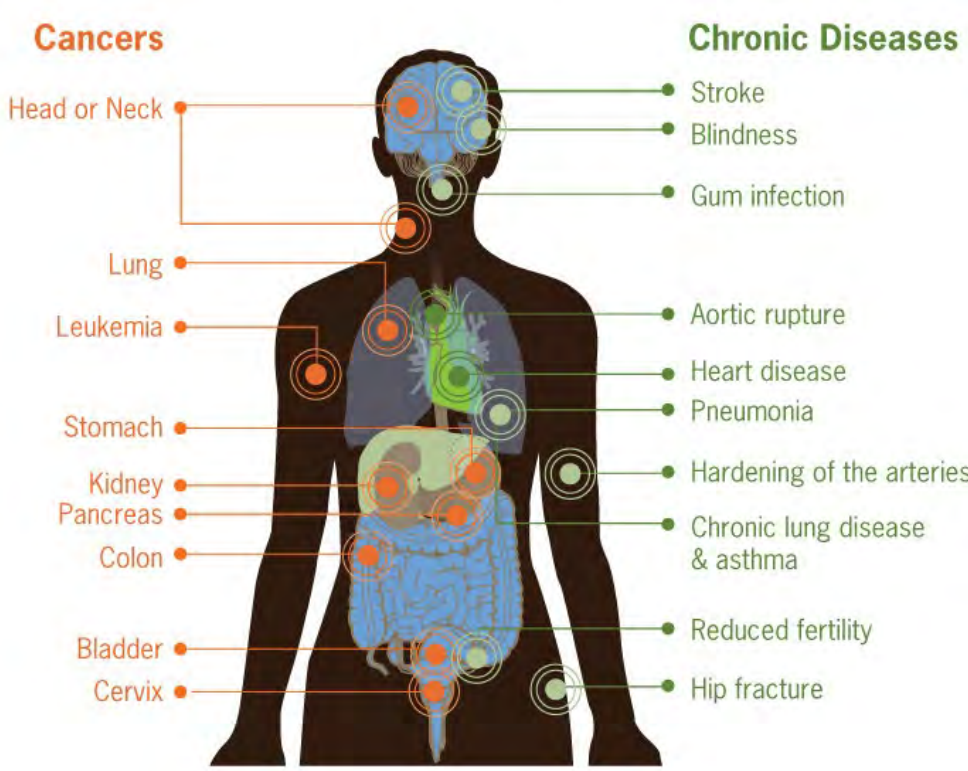


Unknown Health Risks

Toxic exposures of E-cigarettes to the user?

Puff for puff relative to combusted tobacco: MUCH LOWER RISK

- No tar, so far fewer carcinogens, but….
- Nicotine: cardiovascular consequences
- Ultrafine particles: cardiovascular, pulmonary and inflammatory effects
- VOCs/acrolein/formaldehyde/other aldehydes / flavoring chemicals: inflammatory effects, growing concerns for decreased lung function



Above: COMBUSTED tobacco risks

Relative to NO tobacco or medical NRT: MUCH CONCERN

Significant Concerns about Flavors: many at 1-2% of solution, with inflammatory, irritant or cytotoxic effects

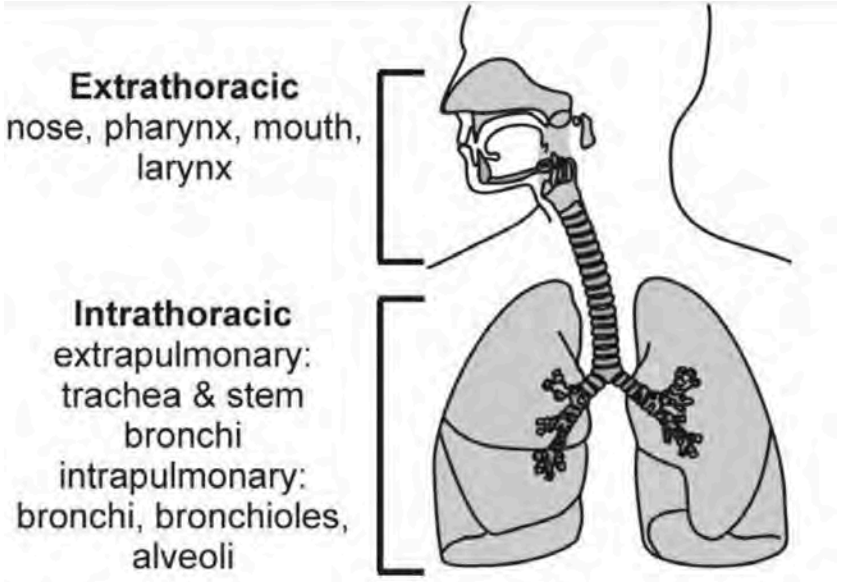
FLAVORS HAVE NOT BEEN TESTED FOR INHALATION SAFETY

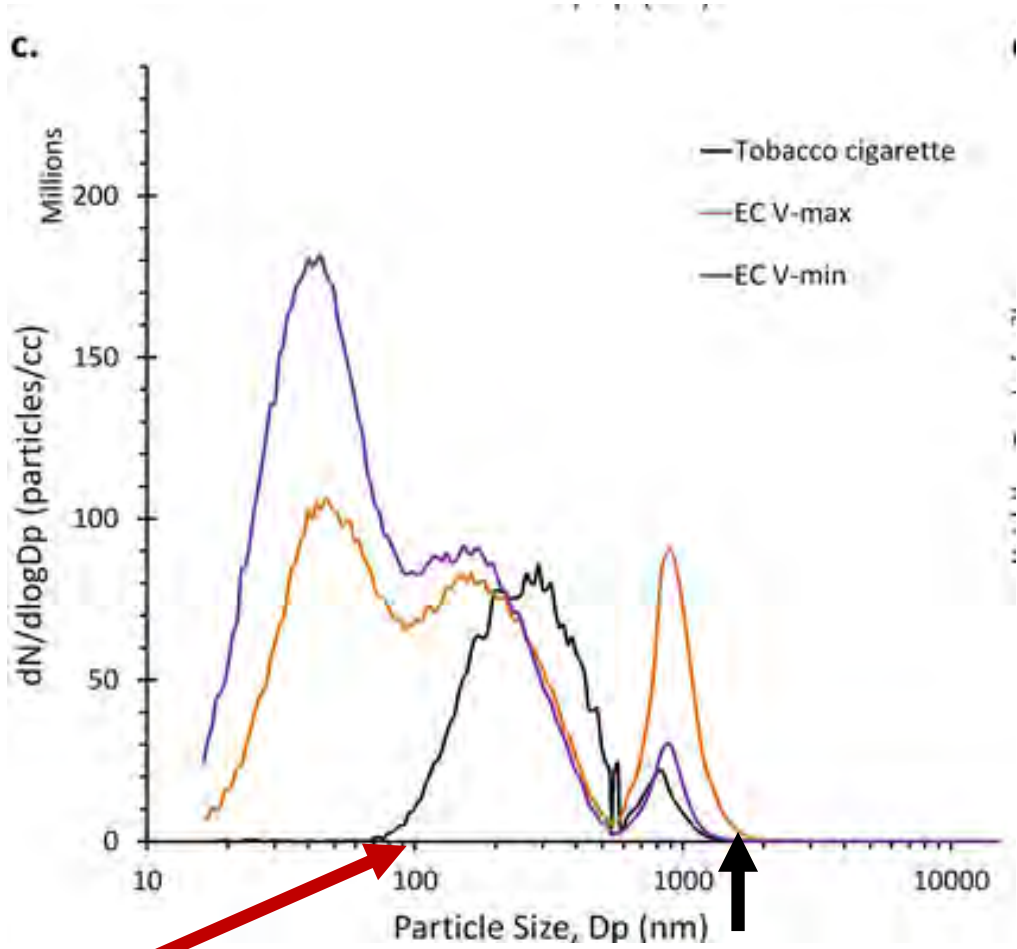
100's of different toxicant profiles (combinations), most yet to be determined

- Menthol (mint) – lots of studies - anesthestic
- Diacetyl (butter) – lung tissue destruction
- Cinnamaldehyde (Cinnamon) – cell death
- Benzaldehyde (fruit flavors) - irritant
- Furfural (sweet, sugar, caramel) – irritant, tumors on mice

Kaur et al, *Toxicology Letters*, 2018

Particle size affects respiratory tract deposition dose to tissues, potential toxicity and environmental behavior

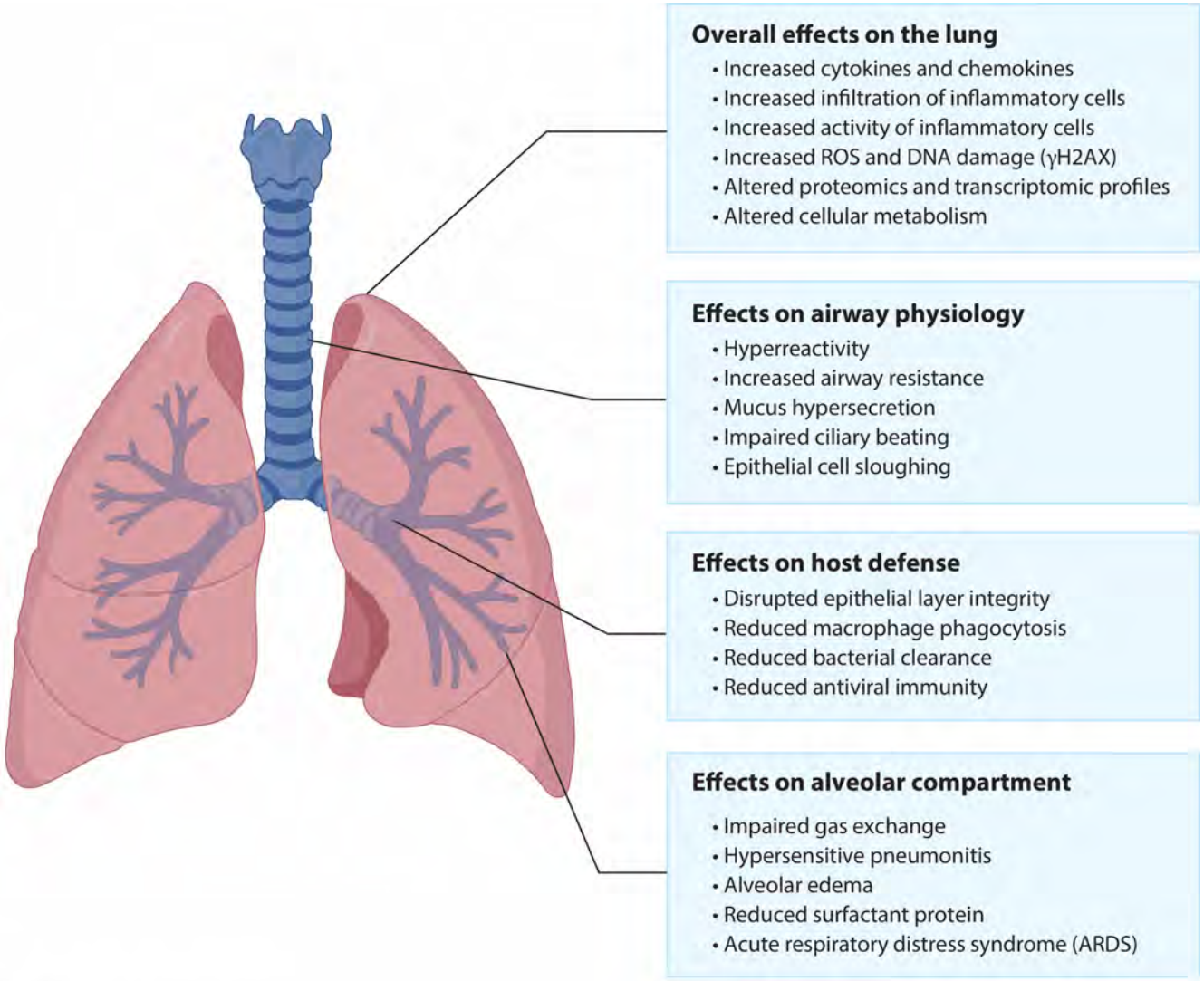




- **PM_{10}** : inhalable particles, with diameters that are generally 10 micrometers and smaller
- **$PM_{2.5}$** : fine inhalable particles, with diameters that are generally smaller than 2.5 micrometers. Can enter circulation through lung inhalation
- **Ultrafine particles** – 0.1 micrometer – greatest health effects, trigger inflammation, heart disease, stroke

Floyd et al. PLOS One 2018

Vape-induced inflammation effects lung function



Overall effects on the lung
- Increased cytokines and chemokines
- Increased infiltration of inflammatory cells
- Increased activity of inflammatory cells
- Increased ROS and DNA damage (γH2AX)
- Altered proteomics and transcriptomic profiles
- Altered cellular metabolism

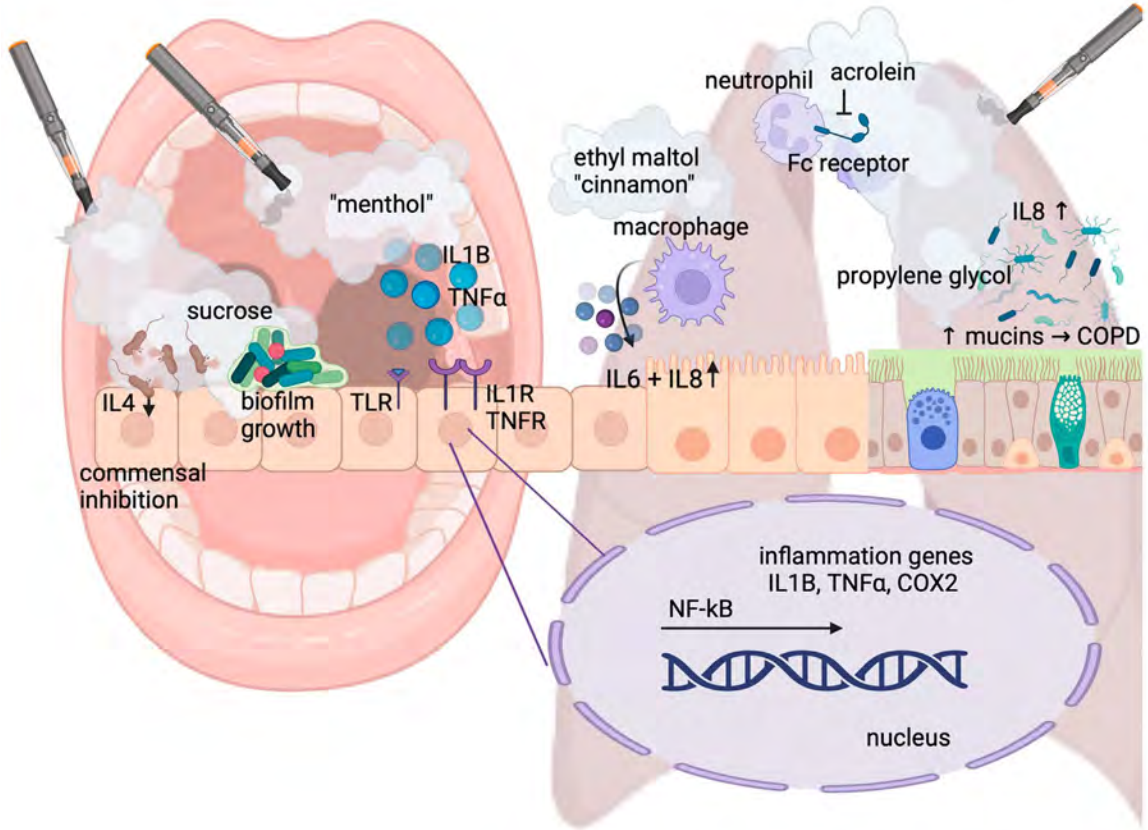
Effects on airway physiology
- Hyperreactivity
- Increased airway resistance
- Mucus hypersecretion
- Impaired ciliary beating
- Epithelial cell sloughing

Effects on host defense
- Disrupted epithelial layer integrity
- Reduced macrophage phagocytosis
- Reduced bacterial clearance
- Reduced antiviral immunity

Effects on alveolar compartment
- Impaired gas exchange
- Hypersensitive pneumonitis
- Alveolar edema
- Reduced surfactant protein
- Acute respiratory distress syndrome (ARDS)

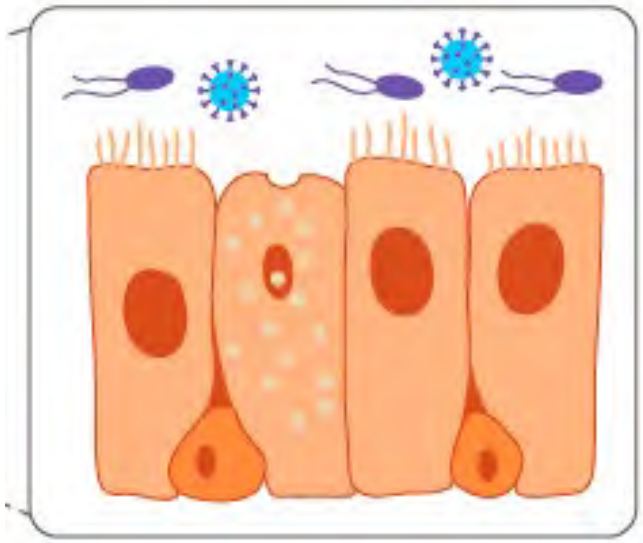
Park J-A, et al. 2022

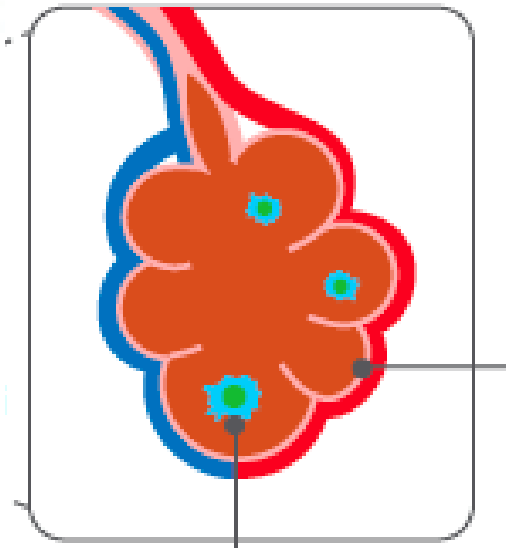
[Park et al, Annual Review of Physiology https://doi.org/10.1146/annurev-physiol-061121-040014]



Cells **2023**, *12*(21), 2552; [https://doi.org/10.3390/cells12212552]

Health Risks: Evidence for changes in lung function





PG/VG alone

- may dehydrate airway surface liquid, making it harder to clear small particles
- Can induce stress due to imbalance of hydration, causing inflammation which can disrupt mucous/surfactant balance

Nicotine

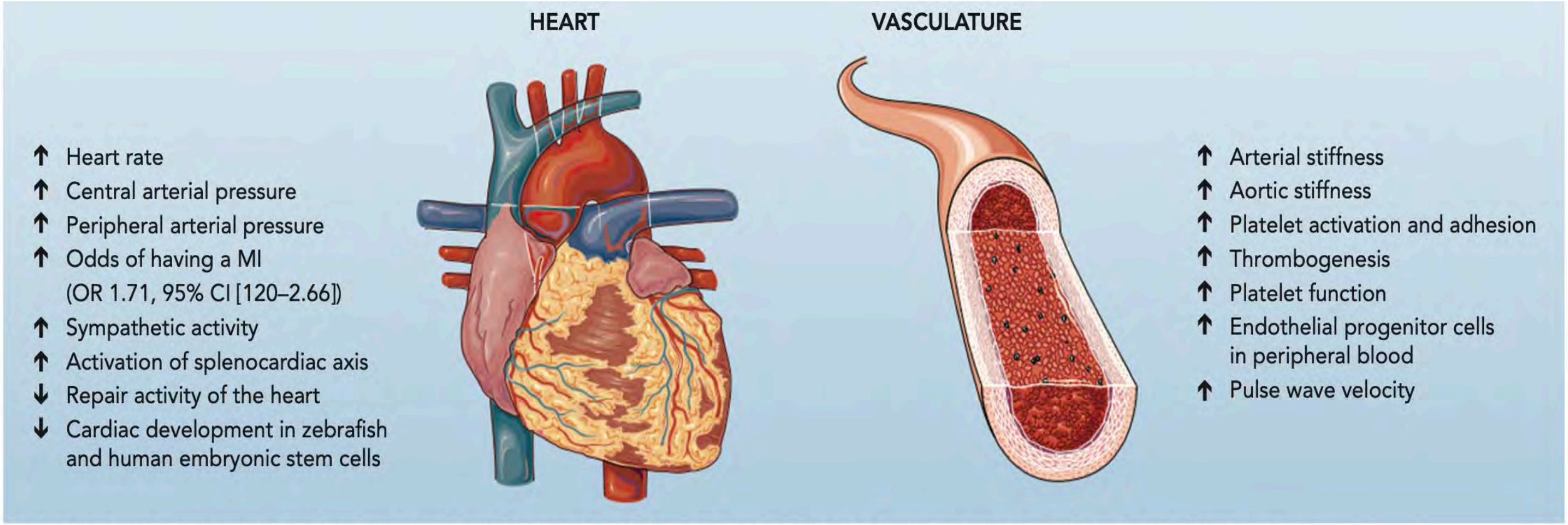
- Can make airways “twitchy” leading to wheeze and difficulty breathig

Flavorings

- Poison to cells in lung, inflammation

Gotts et al, *BMJ* 2019

Vape impacts on cardiovascular function – many related to nicotine alone



OR = odds ratio; Source: Central images kindly provided by Servier. Servier Medical Art is licensed under a Creative Commons Attribution 3.0 Unported License.

So what ARE we sure of?

- Nicotine is highly addictive and has powerful full-body effects
- The vaping industry seeks profit, and tunes their products to make customers
- Vaping carries much less risk than smoking, but long term risks are unknown
- We should support adolescents to NOT vape
- Quitting nicotine is hard

- That’s what is coming up in the next ECHO sessions….