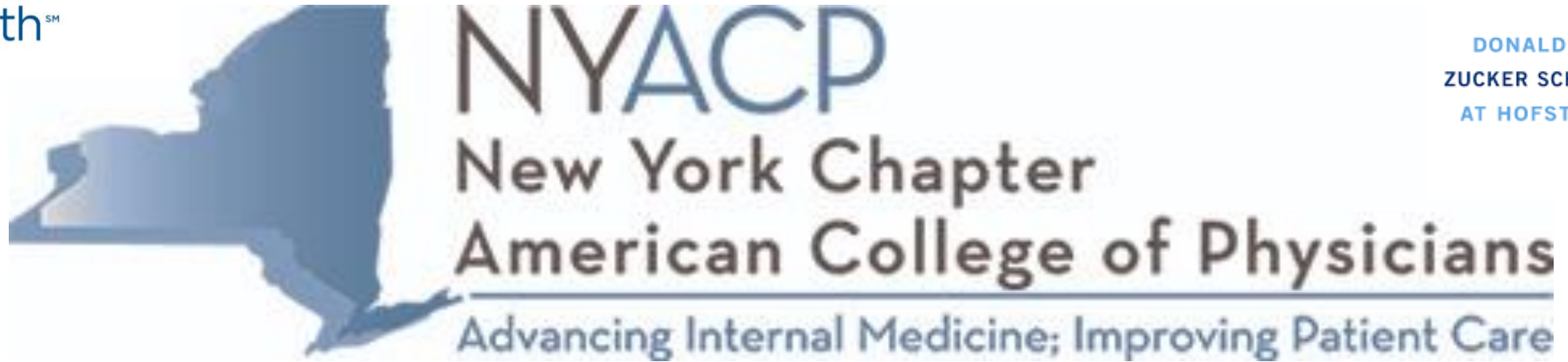




Vaping Associated Pulmonary Injury

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Assistant Professors of Medicine

Donald and Barbara Zucker School of Medicine at Hofstra/Northwell
Department of Medicine

Wednesday December 11th, 2019



EVALI

E-cigarette, or Vaping, product use Associated Lung Injury

Disclosures

None

Objectives

Recognize background and terminology of vaping

Recognize the clinical and radiographic manifestations of EVALI

Interpret and apply the CDC guidelines and recommendations

Assess the risks and benefits of using E-cigarettes for smoking cessation

Identify current and next steps in physician advocacy on vaping and regulation

Overview



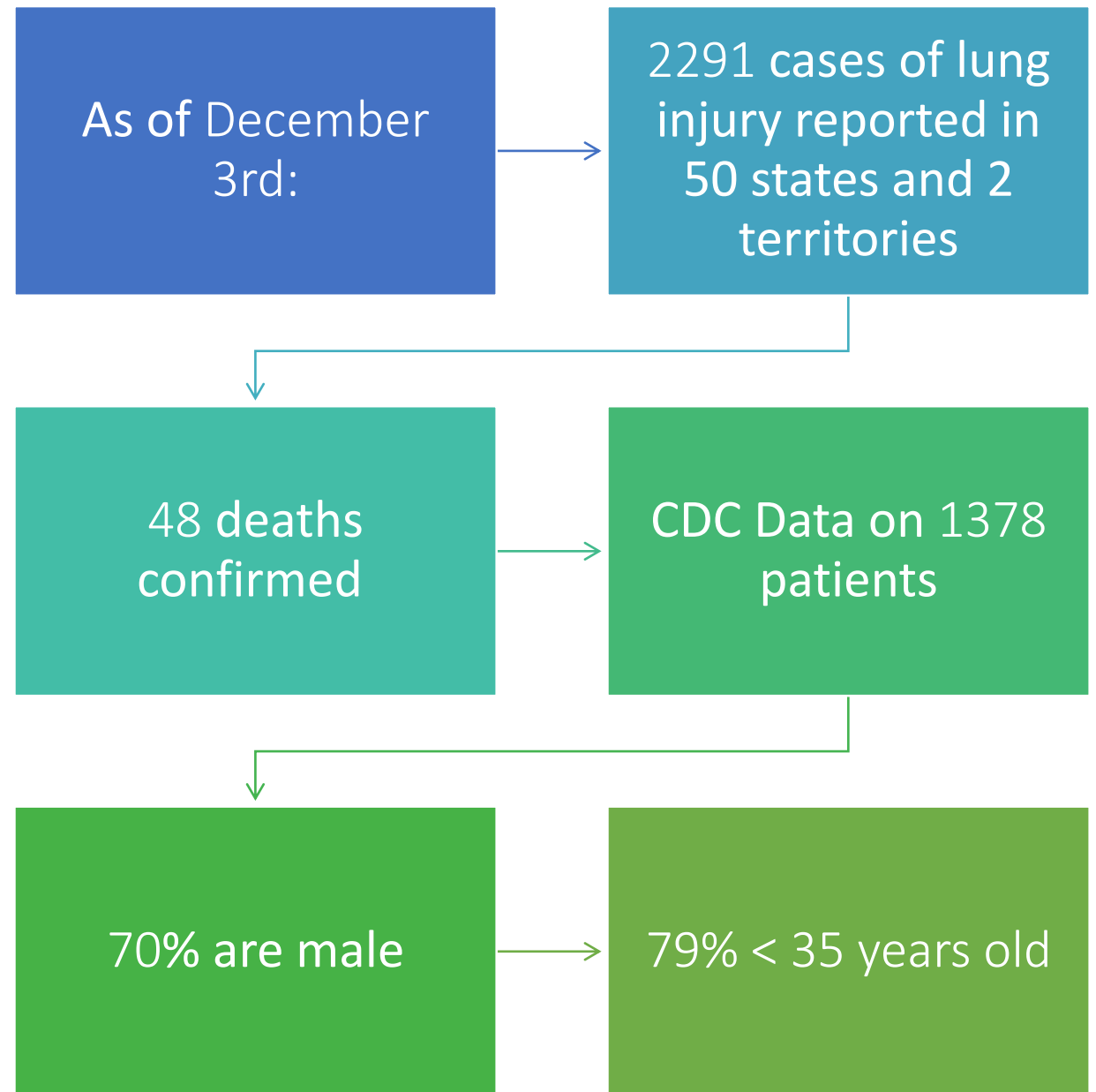
Why are We Here?

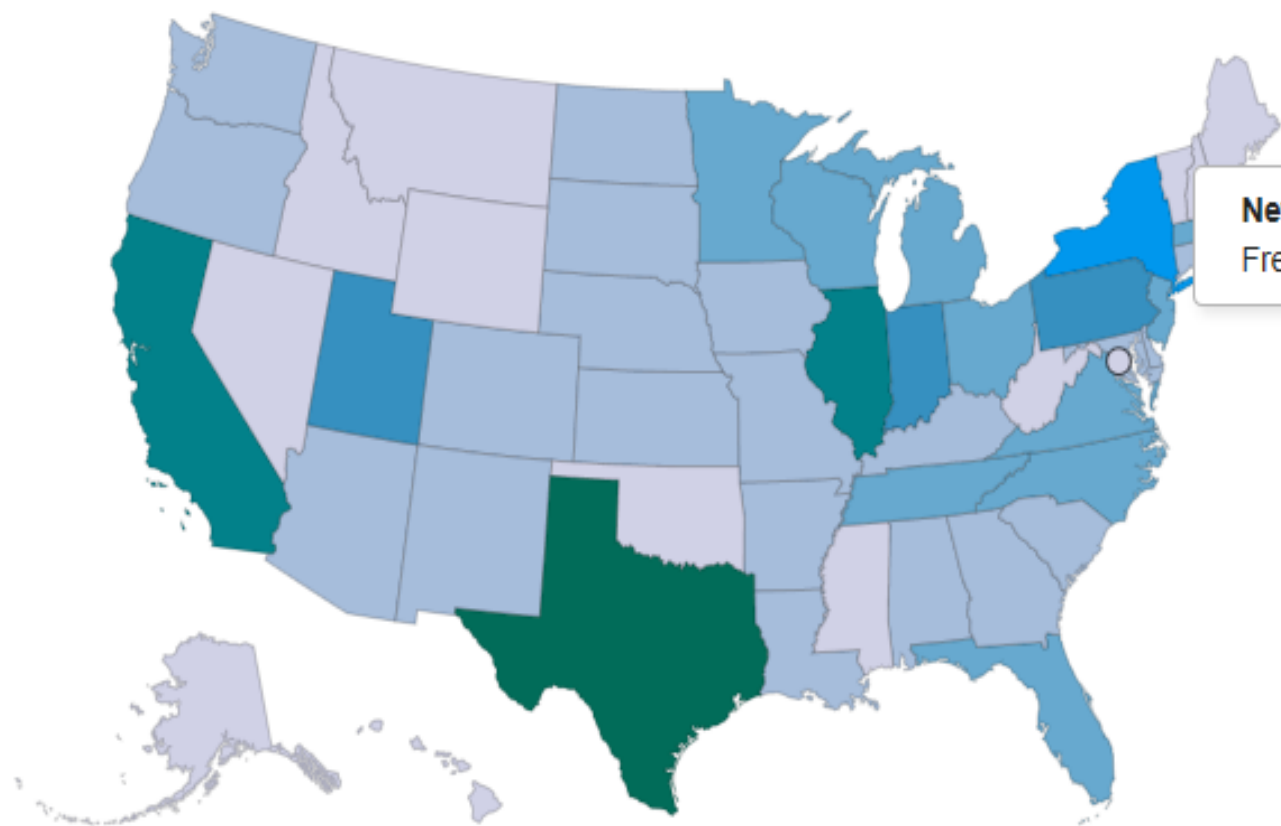
A Young Man Nearly Lost His Life to Vaping

He thought vaping THC would be safer than smoking marijuana, but the fumes shut down his lungs.



What We Know So Far





Legend

New York

Frequency: 100-149 Cases

- 0 cases
- 1-9 cases
- 10-49 cases
- 50-99 cases
- 100-149 cases
- 150-199 cases
- 200-249 cases

injury cases per state

Territories

AS

GU

MH

FM

PW

PR

VI



Data Table



80% using THC-containing product (35% only THC)



54% nicotine containing product (13% only nicotine)

12% CBD containing products (1% only CBD)

5% NO nicotine, THC, or CBD

**CDC Vaping Data
On 1782 Patients**

CDC Data on THC-containing products



- 152 different THC-containing product brands reported by EVALI patients
 - Dank Vapes (Northeast and South)
 - TKO and Smart Cart (West)
 - Rove (Midwest)

Presenting Symptoms

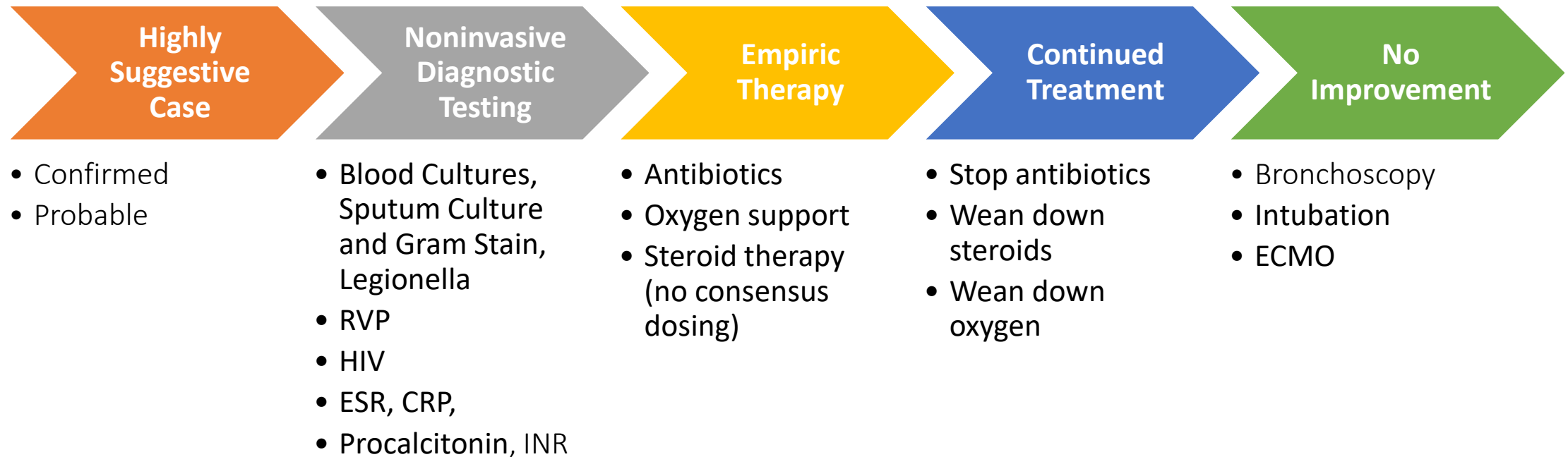
NEJM (n = 53)

- Respiratory Symptoms – 98%
- GI Symptoms – 81%
- Constitutional Symptoms – 100%

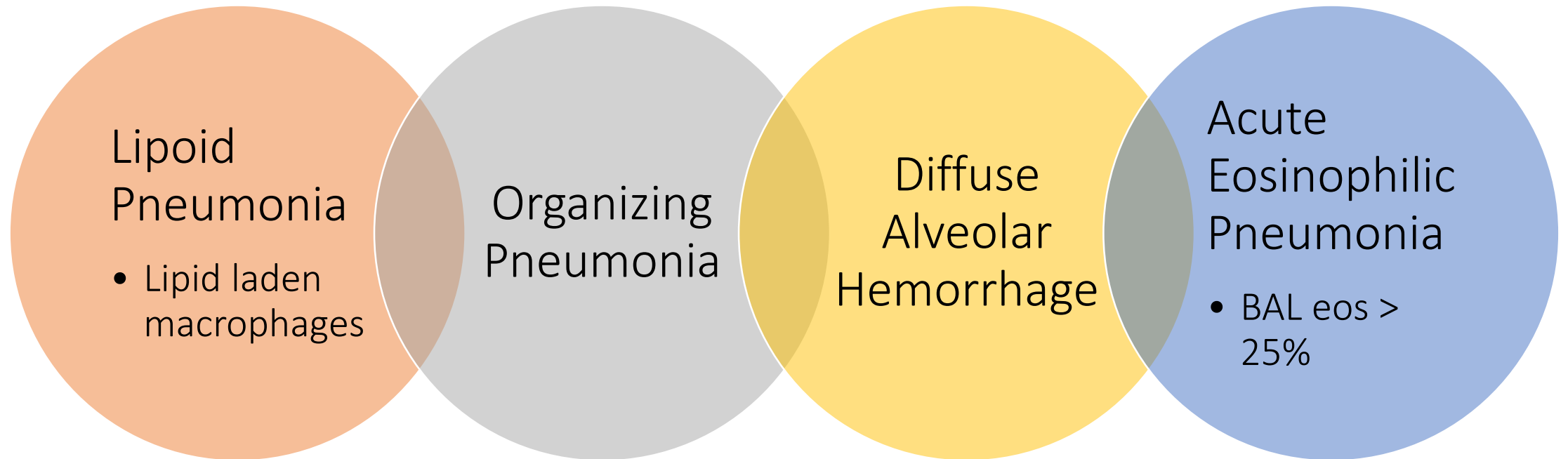
CDC (n = 393)

- Respiratory Symptoms – 95%
- GI Symptoms – 77%
- Constitutional Symptoms – 85%

Evaluation and Management



Pathology



Invasive testing not required

Background





The Basics



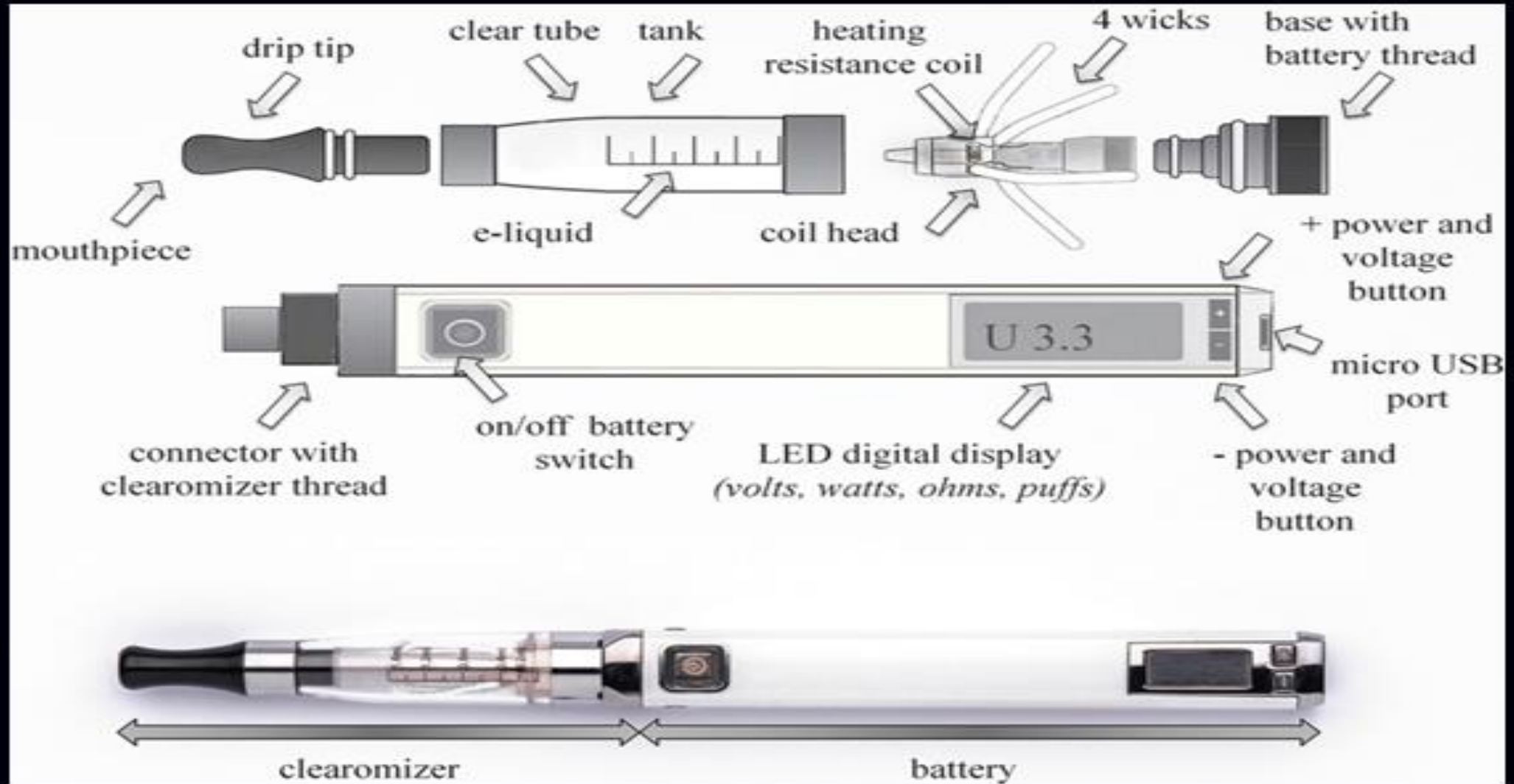
Vaping products include devices, liquids, flavorings, refill pods, and cartridges



Devices heat liquids to produce an aerosol that is inhaled by user



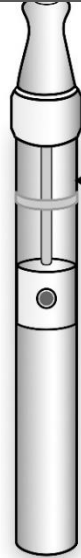
Vaping aerosol can contain harmful or potentially harmful substances





**First Generation:
Cig-alike**

- Often disposable
- Single power setting



**Second Generation:
Pen Style**

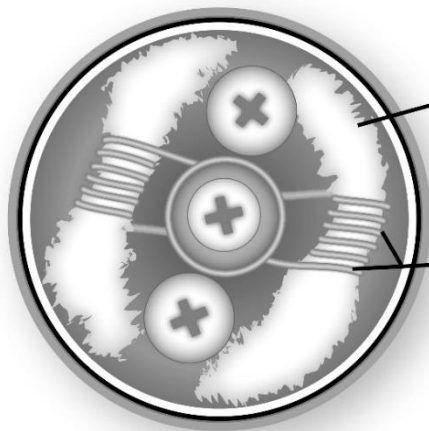
- Longer lasting battery
- Larger clearomizer capacity



**Third Generation:
Mods and Customizables**

- User control over power and airflow settings
- Refillable clearomizers
- Highly customizable

B



Wick:
cotton, silica, ceramic

Coil:
NiChrome, kanthal, etc.

Material	Known Risks
Silica	Silicosis
Nickel	Carcinogenesis, lung injury, immune suppression
Chromium	Carcinogenesis, lung injury, immune suppression, reproductive toxicity





Smoking Cessation



A Randomized Trial of E-Cigarettes versus Nicotine-Replacement Therapy

Peter Hajek, Ph.D., Anna Phillips-Waller, B.Sc., Dunja Przulj, Ph.D., Francesca Pesola, Ph.D., Katie Myers Smith, D.Psych., Natalie Bisal, M.Sc., Jinshuo Li, M.Phil., Steve Parrott, M.Sc., Peter Sasieni, Ph.D., Lynne Dawkins, Ph.D., Louise Ross, Maciej Goniewicz, Ph.D., Pharm.D., et al.

February 14, 2019



U.K. National Health Services Quit Smoking Services

Multisession Behavioral Support

Nicotine Replacement Group vs E-cigarette Group

Sustained 1 year abstinence 18.0% (EC) vs 9.9% (NRT)

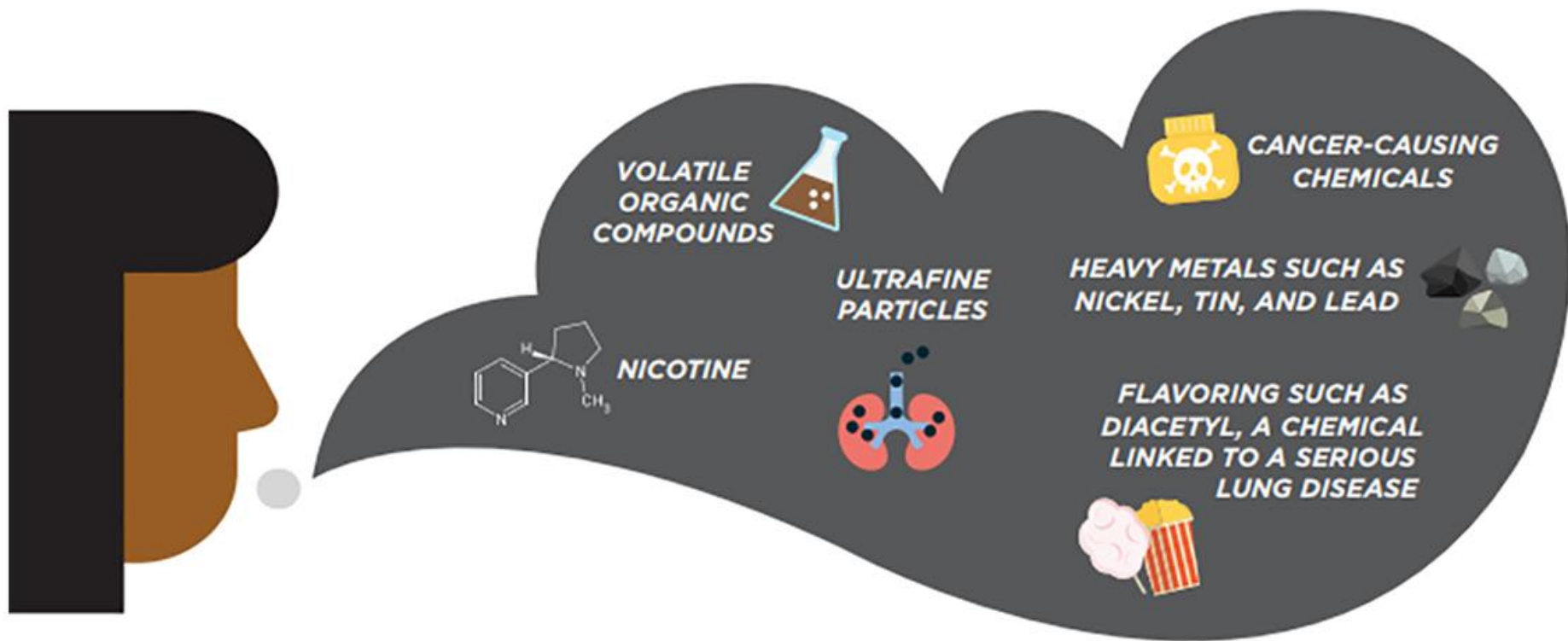
NNT 12 patients – to have 1 sustained abstinence

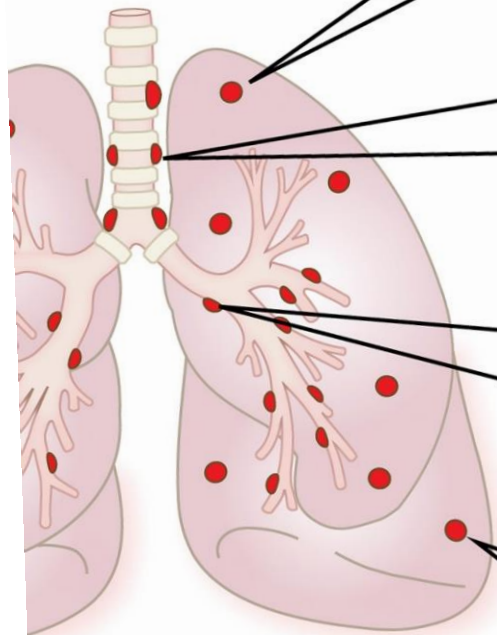
EC provided greater satisfaction and were rated as more helpful to refrain than NRT

At 1 year – in those with abstinence – 80% were using EC and 9% were using NRT

What's the Harm?

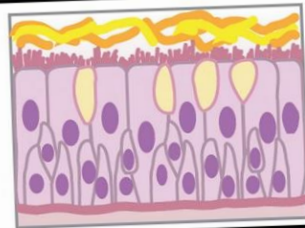






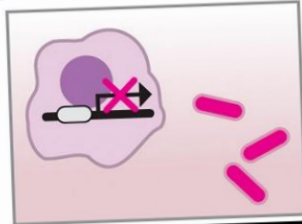
Overall Effects on the Lung:

- Decreased exhaled nitric oxide (89, 127)
- Development of respiratory symptoms in adolescents (30, 93, 130)
- Cytotoxicity and increased lung weight (26, 61, 113)



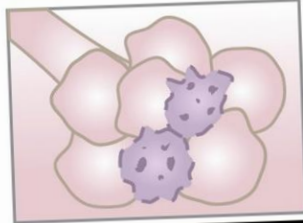
Effects on Airway Physiology:

- Airway hyperreactivity (81)
- Increased airway resistance (49, 127)



Effects on Host-Defense:

- Downregulation of host-defense genes (91)
- Decreased antimicrobial activity (121, 137)
- Increased resistance of bacteria to host antimicrobial factors (62)



Effects on Alveolar Compartment:

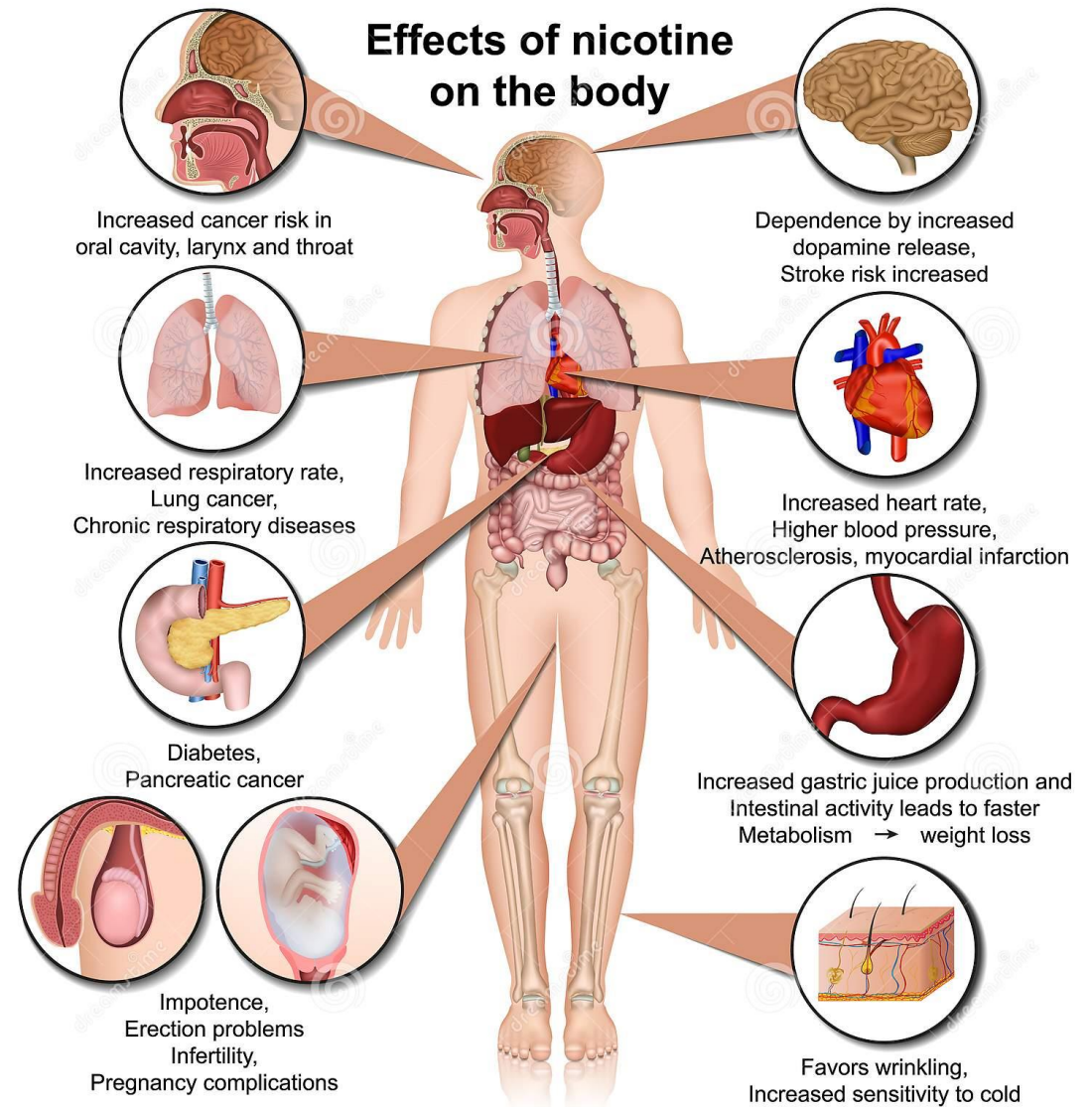
- Decreased alveolar development (94)
- High levels of particle deposition (84)
- Increased levels of necrosis and cytotoxicity (26, 62, 97)

Heavy Metals

- Parts
 - Metallic coils
 - Joints
 - Wires
- Metals:
 - Chromium
 - Nickel
 - Lead
 - Tin

- Hypothesis:
 - *Metals in the coil leach into the aerosol during the heating process.*
- Major increases in metal concentrations in aerosol sample as compared to the unheated e-liquid

Nicotine



Humectants (Delivery Solvents)

Propylene Glycol and Glycerol

- 70:30 "throat hit"
- 50:50 "smoother hit"

FDA Approved – G.R.A.S

- Ingestion

Toxic Carbonyl Compounds on Thermal Decomposition

- Formaldehyde – Carcinogenic
- Acetaldehyde – Possibly carcinogenic

Flavorings

7500+

What is in a JUULPod?

- Nicotine

Despite it's apparent differentiation from Cigarettes, Juul contain a comparable amount of nicotine, the same addictive substance.

- Glycerol & Propylene Glycol

Common water retaining vaporization ingredients

- Benzoic Acid

A 'naturally occurring acid found in the tobacco plant, which is a part of [their] proprietary formulation'

- Flavorants

Juul Pods do not need to meet certain FDA regulations regarding marketing and public health disclosures until 2022. The exact formula their ingredients is also 'proprietary'.



Flavorants



Cinnamaldehyde – damages cilia



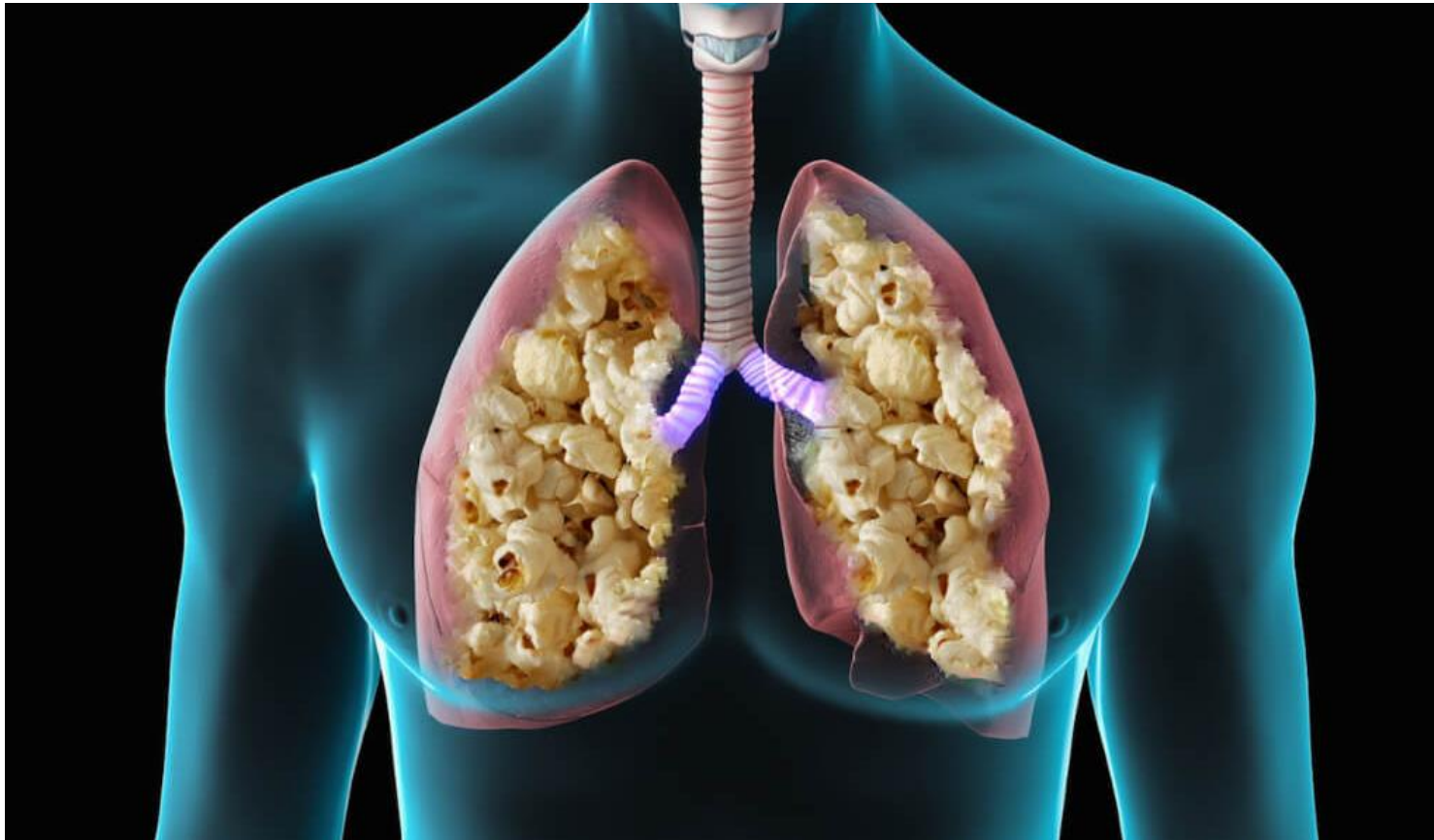
Vanillin – increased IL-6 and decreased NO



Dimethylpyrazine (Strawberry) -
cardiovascular cell death



Combinations – worse



- Butter flavor
- Bronchiolitis obliterans in popcorn manufacturing workers

Diacetyl

Vitamin E acetate

Oil derived from Vitamin E (tocopherol)

Routinely found in vegetable oils, nuts, seeds, green leafy vegetables

Available as Dietary supplement and skin treatment

FDA found Vitamin E acetate in many samples of THC oils but not in nicotine oils

THC oil cutting agent – 2018 (Honey Cutt)

Tocopherols bind to surfactant and impair gas exchange

Destabilizes lipo-hydrophilic balance of surfactant causing occlusion

VAPING CRISIS

INVESTIGATION BREAKTHROUGH



**Chemical
Compound:
Vitamin E
Acetate**

- Safe as Supplement
- Safe on Skin

Harmful if Inhaled

Vitamin E Acetate

CDC Testing

11/8/19

- 29 Patients
- 10 states
- Isotope dilution mass spectrometry to analyze specific toxicants in BAL fluid
 - High Levels
 - Vitamin E acetate – all 29
 - Low Levels
 - Medium Chain Triglycerides
 - Plant Oils
 - Petroleum distillates (mineral oil)
- Cannabinoids
- Nicotine
- DPPC – phospholipid in surfactant – confirms adequate bronchial sampling



Explosions



Type of Injury

Mechanism

Direct Injury

Type 1 – Hand Injury
(7)

Type 2 – Face Injury
(8)

Type 3 – Waist/Groin
(11)

Type 5A – Inhalation
Injury from Device
(2)

Type 4 – House Fire
(7)

Type 5B – Inhalation
Injury from Fire
Started by Device (4)

Indirect Injury

Northwell Experience



Northwell
HealthSM

- **40 cases**
- **M(32):F(8)**
- **Age: 24.5 (18-68)**
- **THC - 39**
- **HiFlow of BIPAP- 21**
- **Intubation - 2**
- **ECMO – 3**
- **Bronchoscopy - 14**
- **Death - 0**

Cases



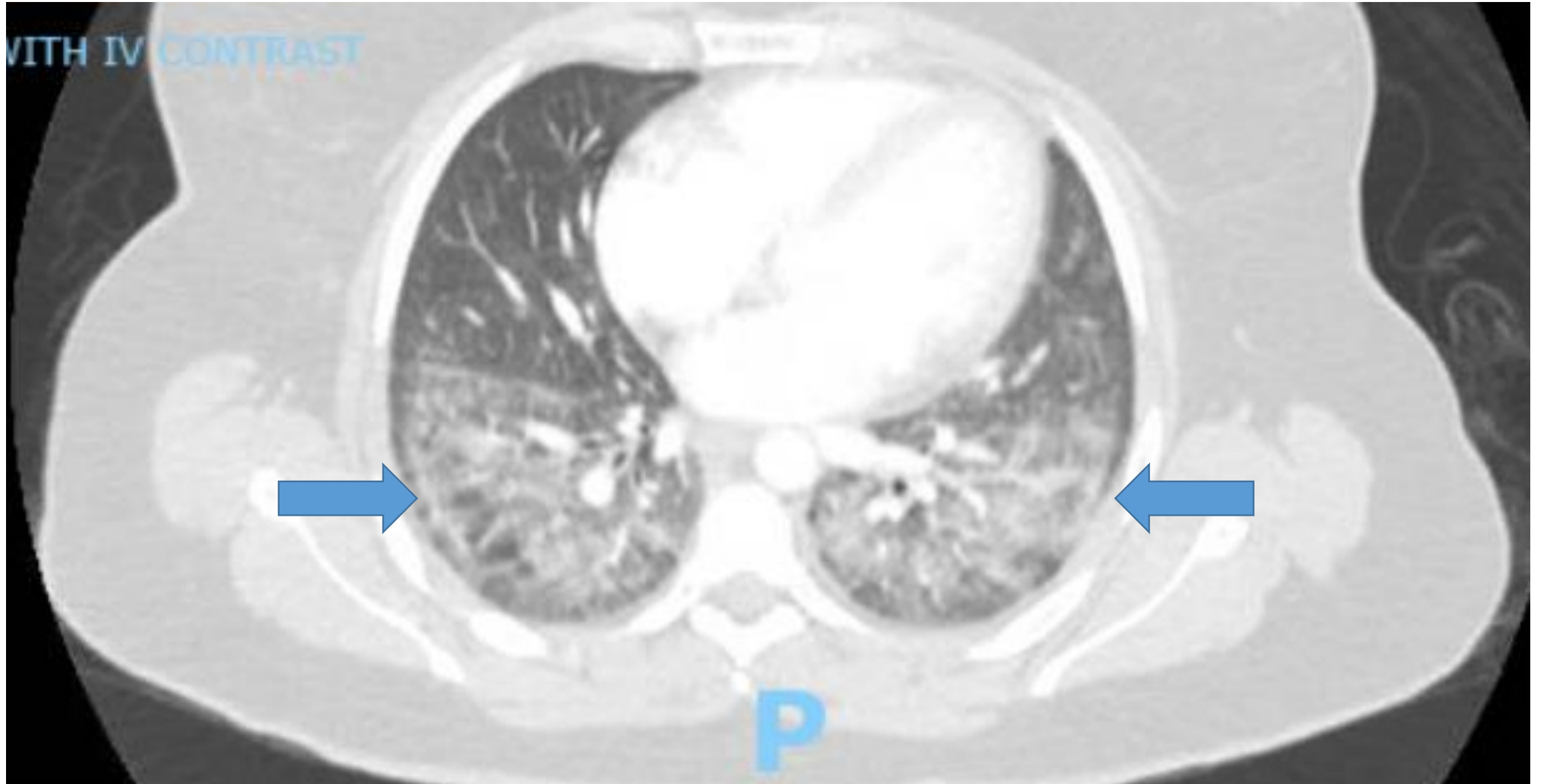
Case 1: 33-year-old female

- Fevers up to 102
- Nonproductive Cough
- Diarrhea
- No response to Z-pack

- Past Medical History:
Anxiety
- Past Surgical History:
D&C
- Recent Travel: None
- Pets: None
- Social History:
 - **Vapes – THC oil weekly x 3 years**
 - Tobacco – denied
 - EtOH - denied
- Employment:
Cafeteria worker

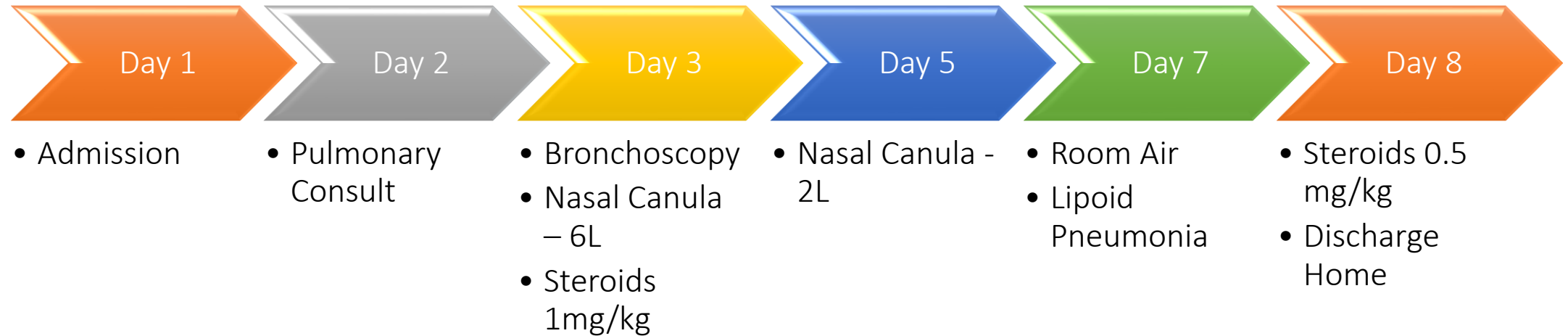
Laboratory Analysis

- WBC 6.5
 - Neutrophils – 72%
 - **ESR 111**
 - **CRP – 26.60**
 - **ANA – 1:320**
 - DsDNA - Negative
 - ANCA – Negative
 - BNP - 131
 - **Utox - THC**
-
- RVP – Negative
 - Urine Legionella – Negative
 - Blood Cultures – Negative
 - Sputum Culture – Negative
 - Urinalysis – Negative
 - HIV – Negative
 - Fungitell - Negative



Diffuse Bilateral Ground Glass Opacities

Clinical Course

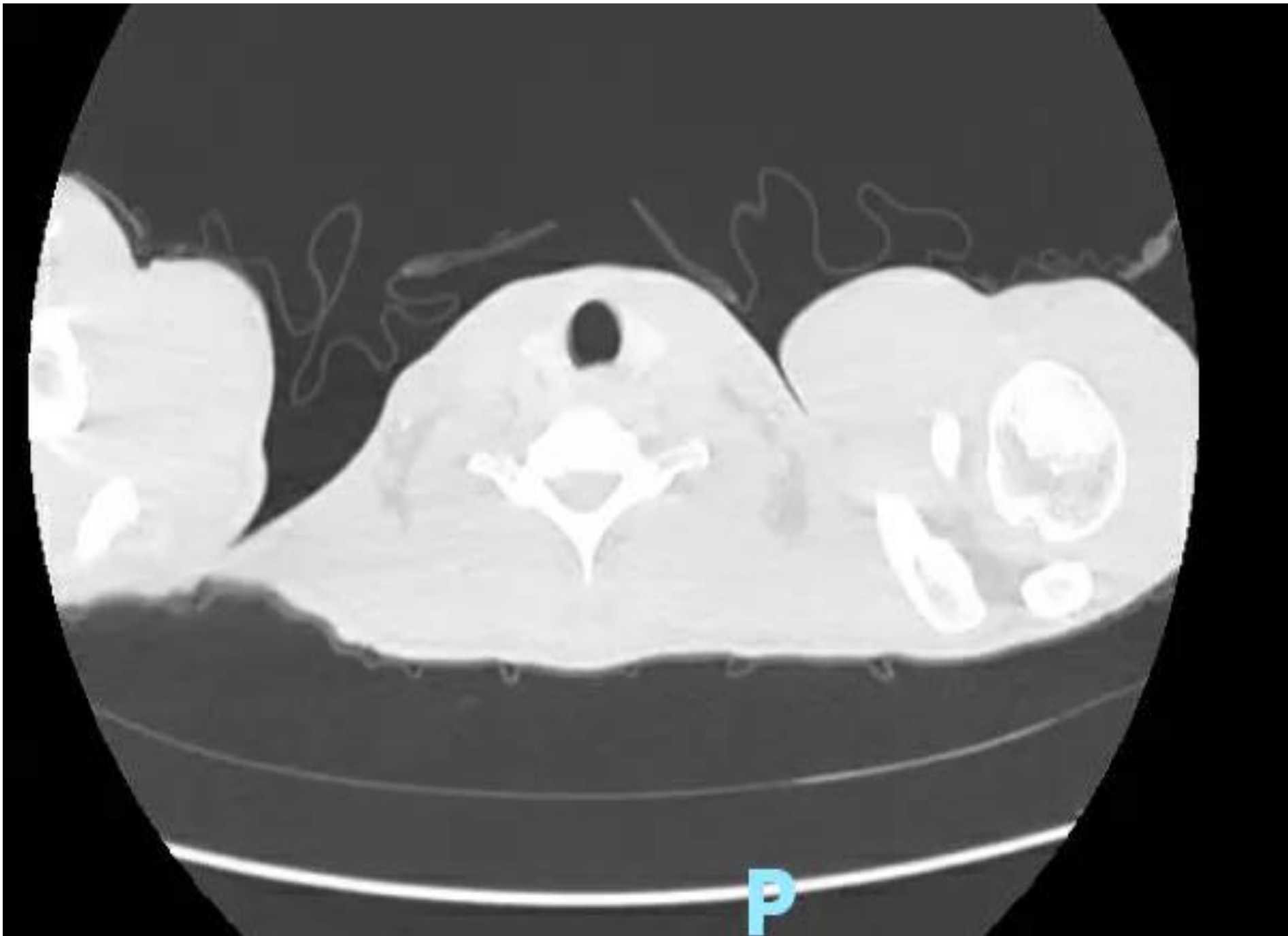


Case 2: 22-year-old male

- Fevers
- Chills
- Malaise
- Fatigue
- Cough
- Decrease PO intake
- Nausea
- Diarrhea
- Headaches
- Past Medical History: None
- Past Surgical History: None
- Recent Travels: None
- Pets: None
- Social History:
 - **Vaping – THC oil Daily x 2 years**
 - Tobacco Use – None
 - EtOH Use – None
- Employment: Waiter

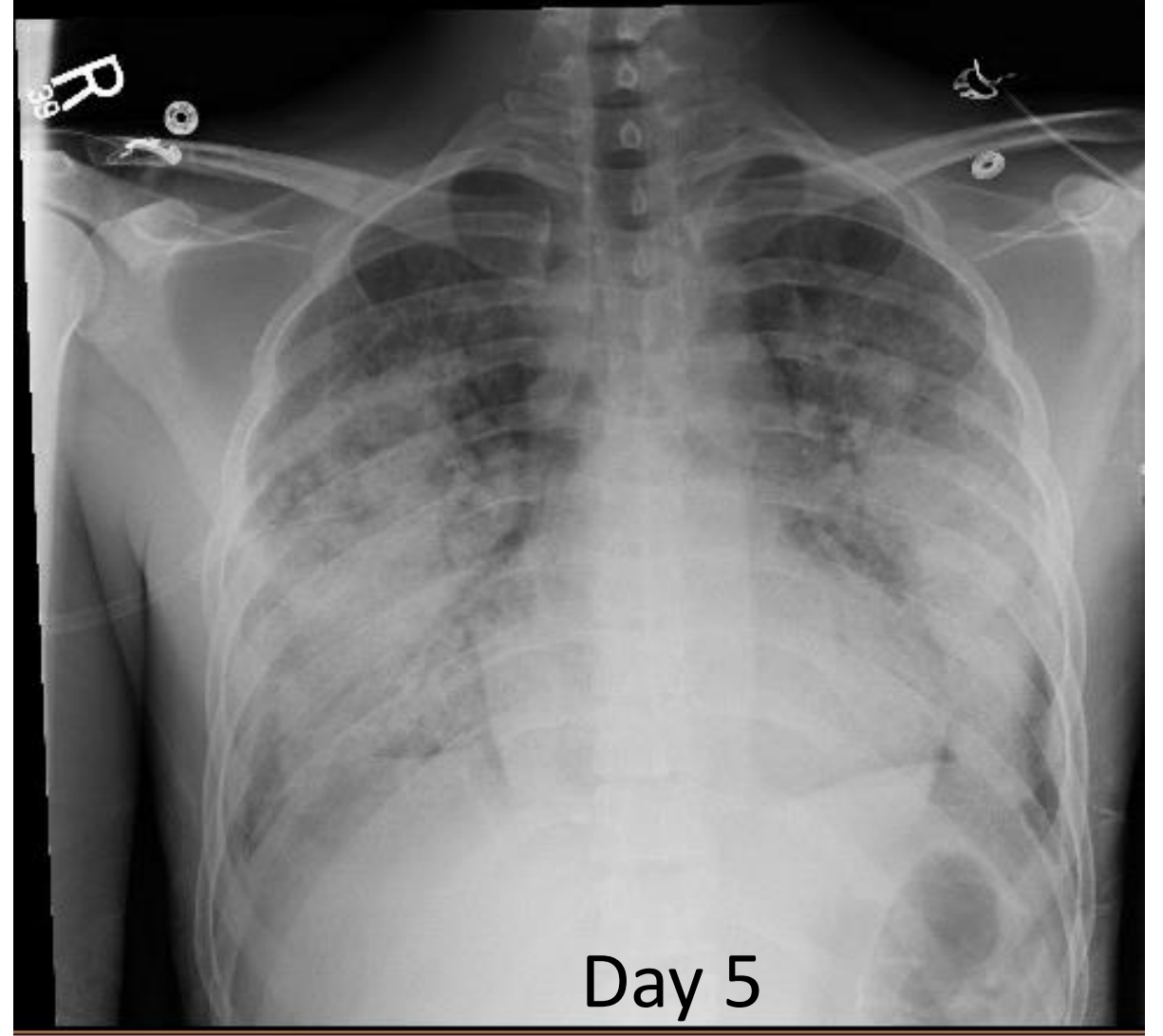
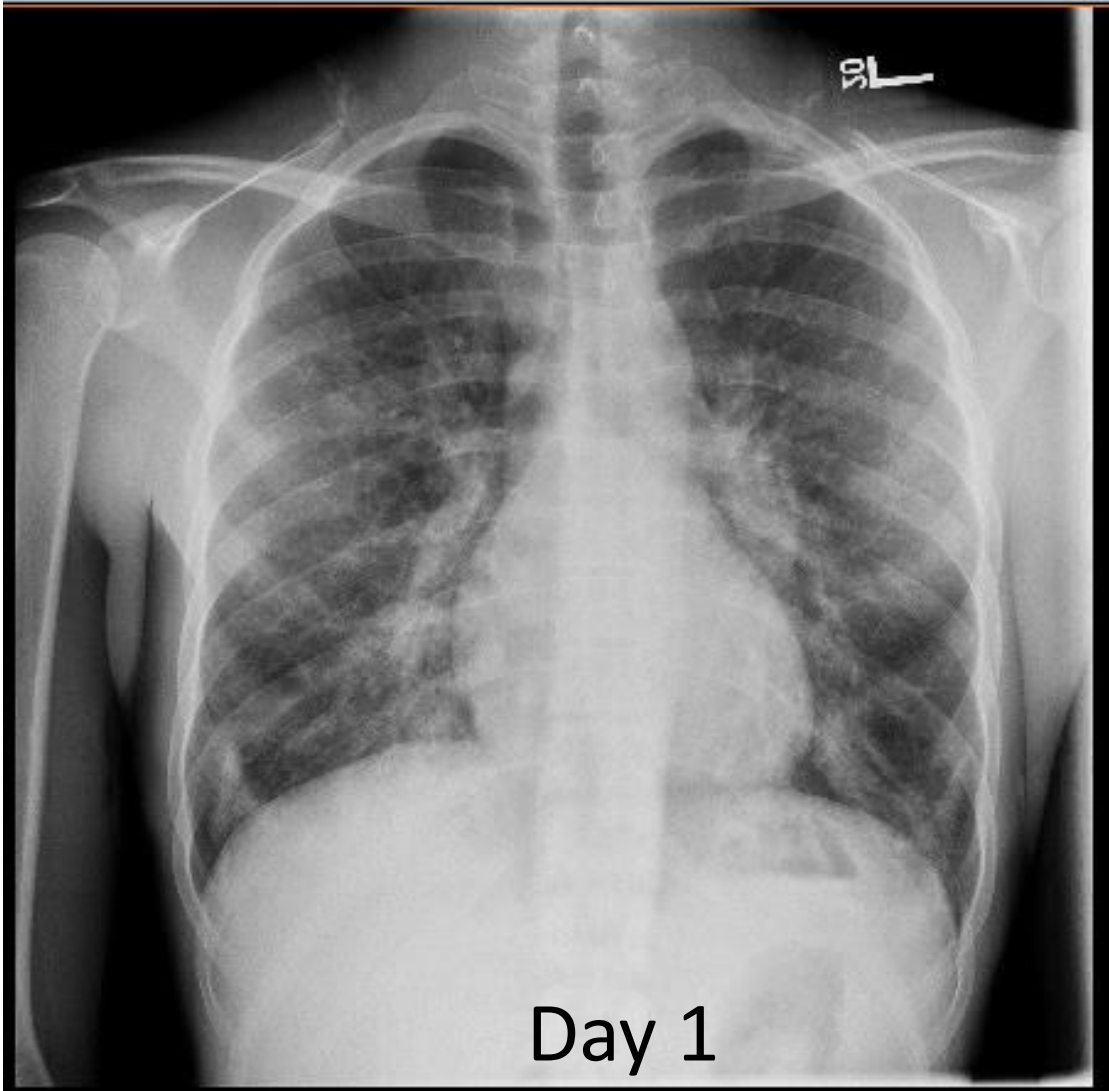
Laboratory Analysis

- WBC 19.6
- Neutrophils – 85%
- **ESR 113**
- **CRP – 29.40**
- ANA - Negative
- ANCA - Negative
- **Utox - THC**
- RVP – Negative
- Legionella – Negative
- Blood Cultures – Negative
- Sputum Culture – Negative
- Urinalysis – Negative w/ no blood
- HIV – Negative
- GI PCR – Negative
- C. diff - Negative

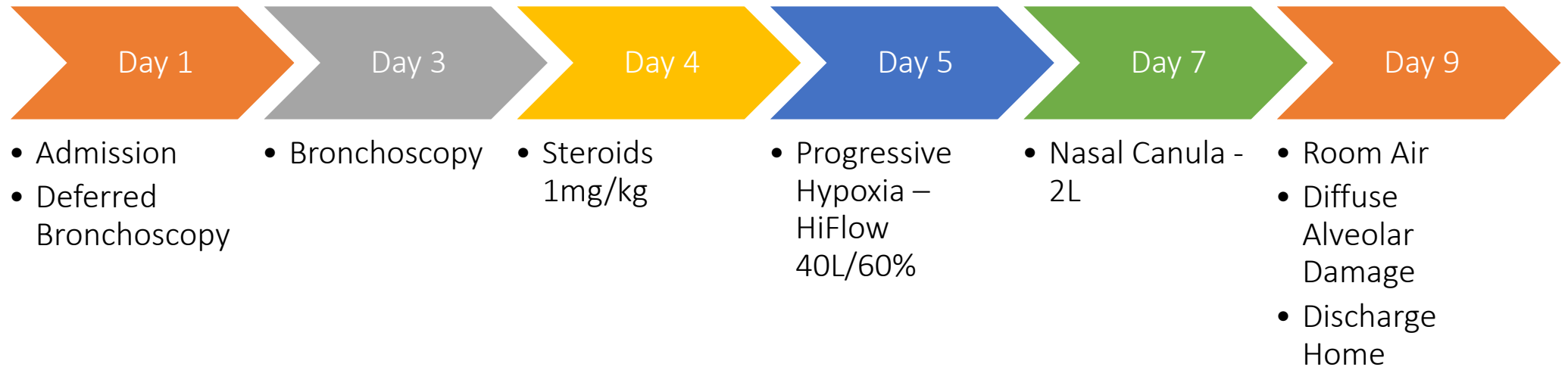


IMPRESSION:

Diffuse curvilinear ground glass and consolidative opacities throughout the lungs bilaterally. Primary diagnostic consideration is multifocal infection versus inflammatory changes/interstitial lung disease.



Clinical Course



Vaping products



CDC Guidelines & Recommendations



Table 1. Outbreak Surveillance Case Definitions of Severe Pulmonary Disease Associated with E-Cigarette Use — August 30, 2019.*

Confirmed case

Use of an e-cigarette (vaping) or dabbing in 90 days before symptom onset; and

Pulmonary infiltrate, such as opacities on plain-film radiograph of the chest or ground-glass opacities on chest CT; and

Absence of pulmonary infection on initial workup: the minimum criteria include negative respiratory viral panel and influenza PCR or rapid test if local epidemiology supports testing. All other clinically indicated testing for respiratory infectious disease (e.g., urine antigen testing for *Streptococcus pneumoniae* and legionella, sputum culture if productive cough, bronchoalveolar-lavage culture if done, blood culture, and presence of HIV-related opportunistic respiratory infections if appropriate) must be negative; and

No evidence in medical record of alternative plausible diagnoses (e.g., cardiac, rheumatologic, or neoplastic process)

Probable case

Using an e-cigarette (vaping) or dabbing in 90 days before symptom onset; and

Pulmonary infiltrate, such as opacities on plain film chest radiograph or ground-glass opacities on chest CT; and

Infection identified by means of culture or PCR, but the clinical team caring for the patient believes that this is not the sole cause of the underlying respiratory disease process; or as the minimum criteria, to rule out pulmonary infection not met (testing not performed) and clinical team caring for the patient believes that this is not the sole cause of the underlying respiratory disease process; and

No evidence in medical record of alternative plausible diagnoses (e.g., cardiac, rheumatologic, or neoplastic process)

Current CDC case definition. Note that this diagnosis does not necessarily require bronchoscopy. This case definition may fail to capture mild or early cases (e.g. prior to development of pulmonary infiltrates).

Layden et al 2019 NEJM

CDC Recommendations

Ongoing
Investigation –
Refrain

Symptoms – See a
Physician

Do Not Buy
black market
products

Do Not Modify

Youth should not
vape

Pregnant women
should not vape

Do Not Start

If you have QUIT
smoking by using E-
cigarettes do NOT
go back to smoking

Social History



VAPING WITHIN PAST 90
DAYS



IDENTIFY SUBSTANCE
USED



CALL POISON
CONTROL/DOH

Knowledge Gaps



What We Don't Know



The specific chemical exposures(s) causing lung injury



No single product or substance has been linked to all lung injury cases



Which vaping products, substances, or brands are responsible for this outbreak

Long Term Outcomes

Nicotine addiction rates

Pulmonary function

Coagulopathy

Cancer Risk

What We
Don't Know

Why America?

Why Now?

Why Severity Varies?

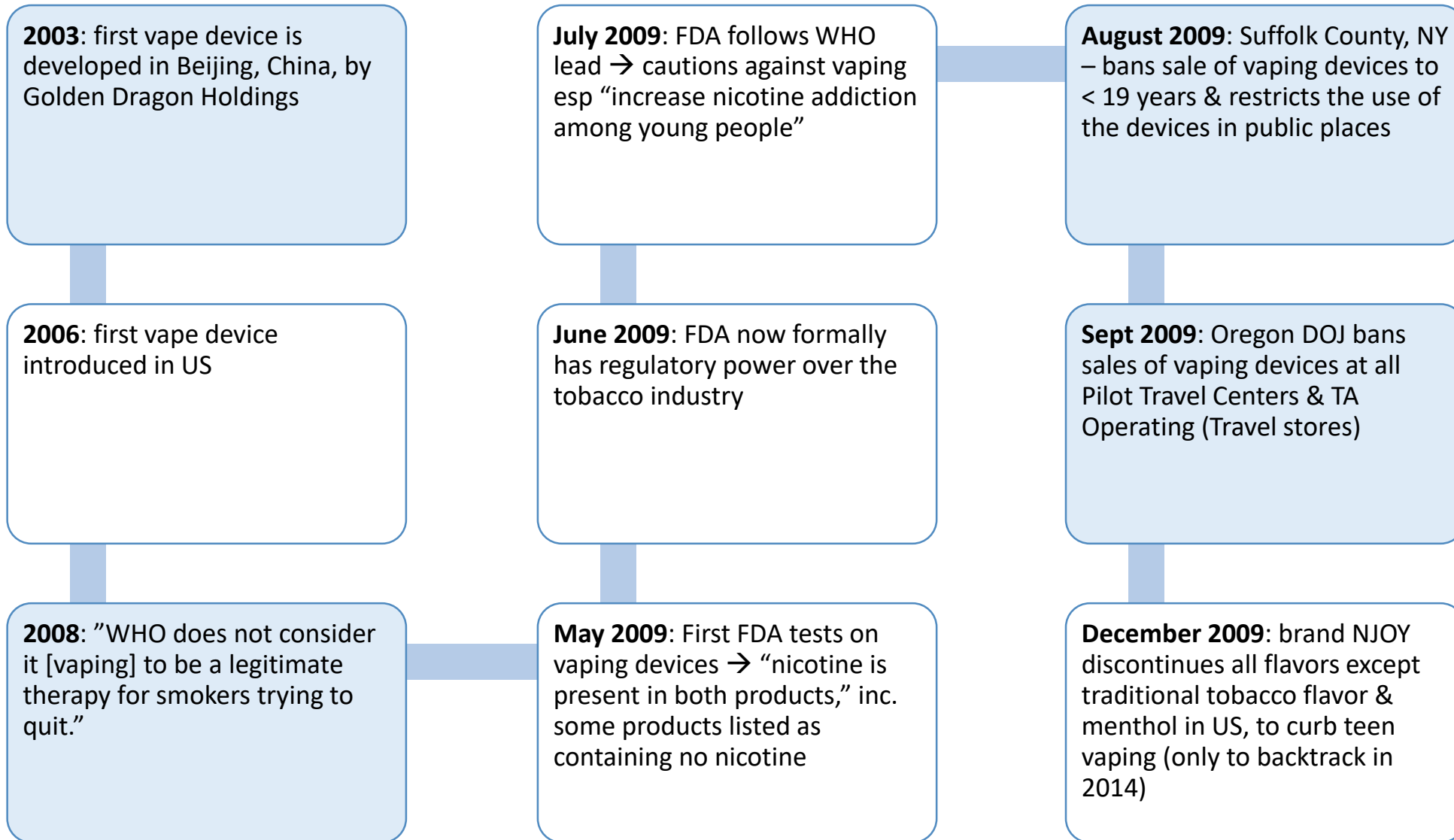
Public Health, Policy, and Advocacy



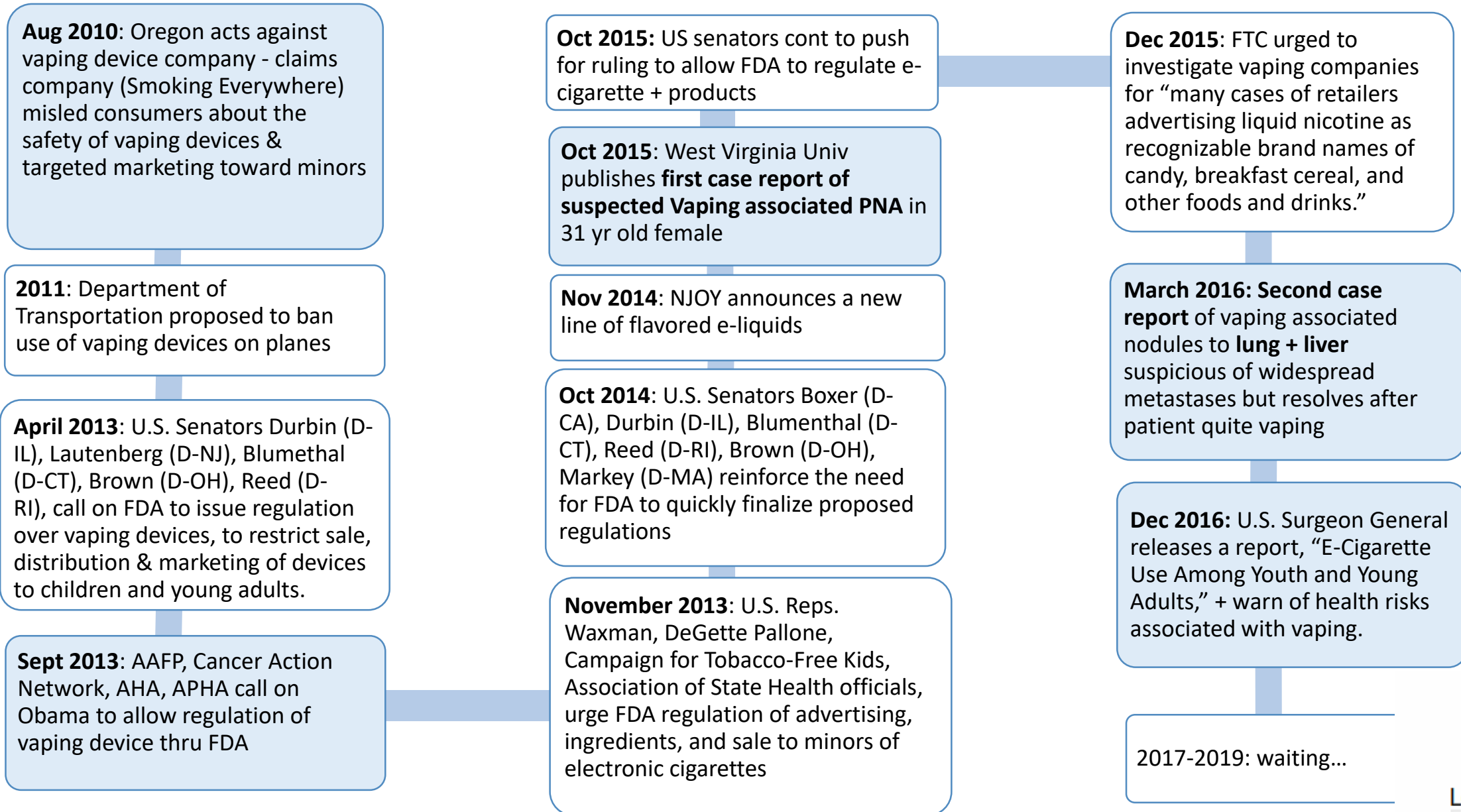
Public Health and Policy



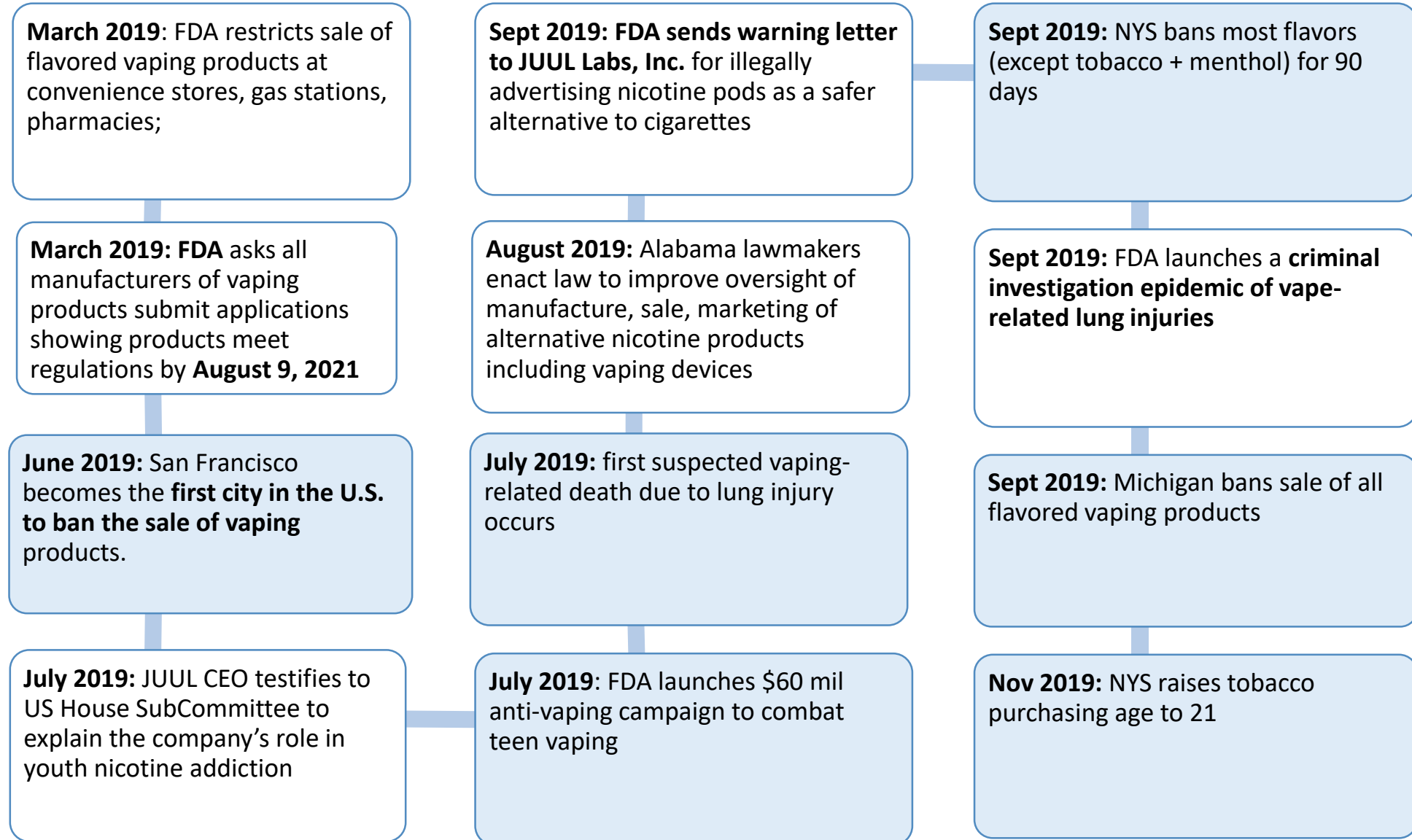
Timeline of Vaping and Policy



Timeline of Vaping and Policy



2019 Timeline of Vaping and Policy



Timeline



2003 → 2019 = 16+ years of
evolution in the technology /
business of electronic cigarettes



Regulation / policy has yet to
catch up



Evidence of benefits and harms
are being identified

Main Issues



TARGETING OF YOUTH



VAPING OF ILLICIT
SUBSTANCES



REGULATION OF E-CIGS



Main Issues: Targeting of Youth

- Multiple investigations nationally; multiple cases against companies such as JUUL
- At this time no clear conclusion on whether flavored products marketing will be held responsible for increase in teen vaping and subsequent nicotine dependence
- Also FDA not clear on its role/desire to ban all flavored e-cigarette products
- AMA, AAP, ACP calls to action:
 1. more e-cigarette regulation due to concerns about short- and long-term health consequences of vaping, especially for children.
 2. ban flavored vaping products, including mint and menthol flavors
 3. raise the national age to buy tobacco and e-cigarettes to 21



Main Issues: Vaping of Illicit substances

- Connection between banning e-cigarette products and increase in illicit substance use for vaping devices
- Several lawmakers have cited the concern about increase use of illicit substances or “at-home” creations for vaping devices
 - Industry backed advocacy groups are increasingly vocal against bans of e-cigarette products (ie American Vaping Association)



Main Issues: Regulation of E-Cigarettes

- 2009: FDA was granted control over regulation of tobacco products
- 2016: FDA finalized their regulatory process for tobacco products
- 2019: current Administration delayed start of regulation process to 2022
- E-cigarette companies filed case in U.S. Court of Appeals: whether the FDA has the authority to treat e-cigarettes as “tobacco products” and to subject the vaping products to the same set of rules and regulations as their conventional counterparts
 - Decision: unanimously YES → FDA has right to regulate and needs to implement the regulation expeditiously in 2020, not 2022
 - E-cigarette products are “indisputably highly addictive and pose health risks, especially to youth, that are not well understood.”

Next Steps



Connect with NYACP – Tobacco and e-cigarette products regulation are part of the legislative priorities for 2020

<https://www.nyacp.org/i4a/pages/index.cfm?pageid=3747>



Create a bridge between organizations for advocacy



Continue to voice concern – it took us 16 years to reach here!

Questions?

