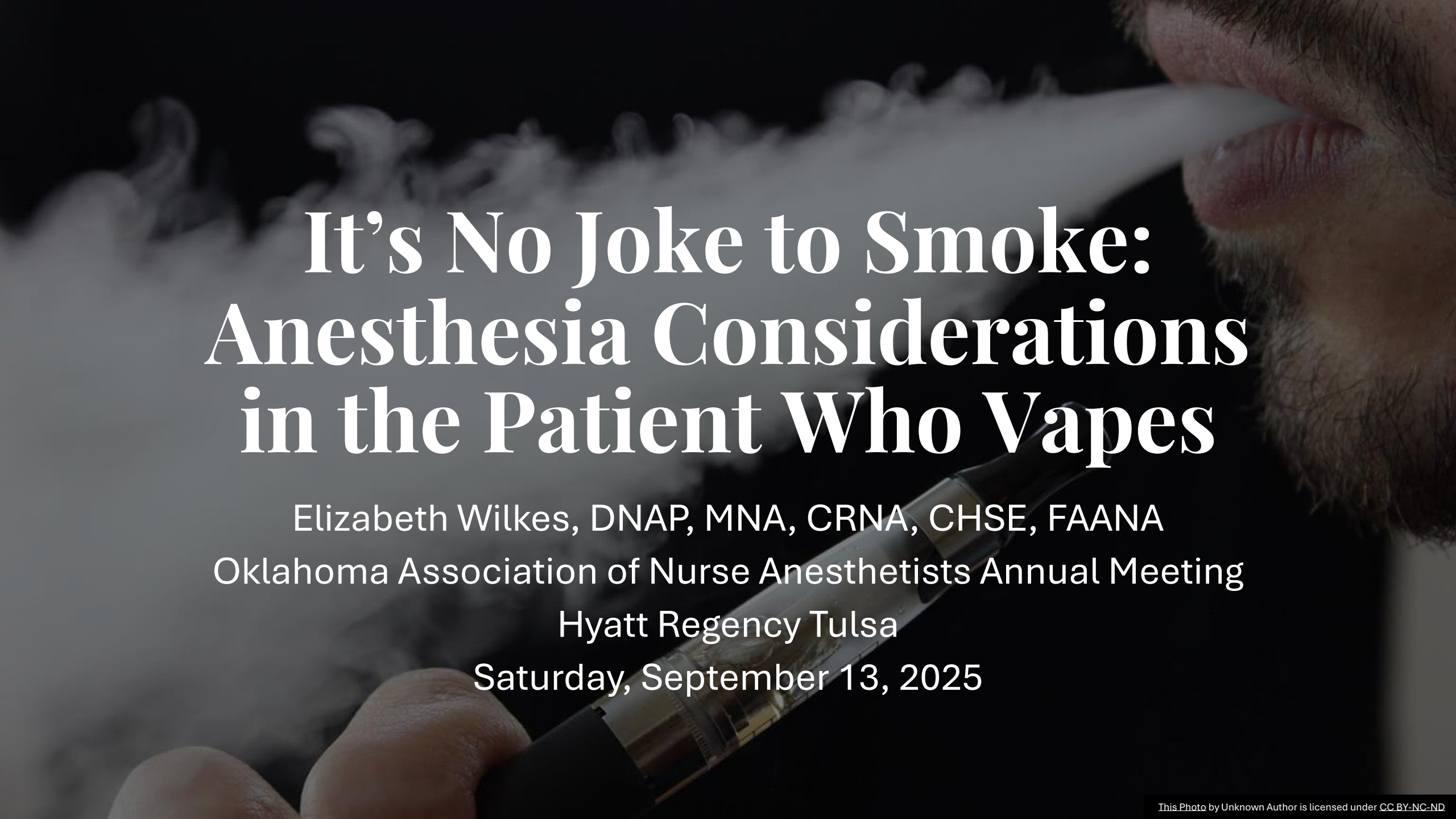


It's No Joke to Smoke: Anesthesia Considerations in the Patient Who Vapes

Elizabeth Wilkes, DNAP, MNA, CRNA, CHSE, FAANA

Oklahoma Association of Nurse Anesthetists Annual Meeting

Hyatt Regency Tulsa

Saturday, September 13, 2025

Disclosure Statement

I have no financial relationships with any commercial interest related to the content of this activity.

I will not discuss any off-label use of medications during this presentation.

I did not use Artificial Intelligence (AI) to create this presentation.

Learner Outcomes

Describe	Describe three components of an Electronic Nicotine Delivery System (ENDS).
Summarize	Summarize three examples of the long-term health effects from the use of vaping products or electronic cigarettes.
Identify	Identify three responses to anesthetic agents in the patient who uses vaping products or electronic cigarettes.
Select	Select an anesthesia management plan for the patient who uses vaping products or electronic cigarettes.

Why did I get interested in vaping?

That was then…(2020)

- 42-year-old healthy female presenting for laparoscopic cholecystectomy
- Proceed to OR, monitors
- Heart rate in the 30's with multifocal PVCs
- Unresponsive to Glycopyrrolate 0.2 mg IV x2 doses, 0.4 mg Atropine IV
- Upon questioning, patient admits to vaping that morning
- Canceled case, sent her to cardiology for follow up

https://quizlet.com/569447800/ecg-flash-cards/

This is now… (2025)

Photo Credit: Josh Rinder


Aiken, South Carolina

A little experiment:

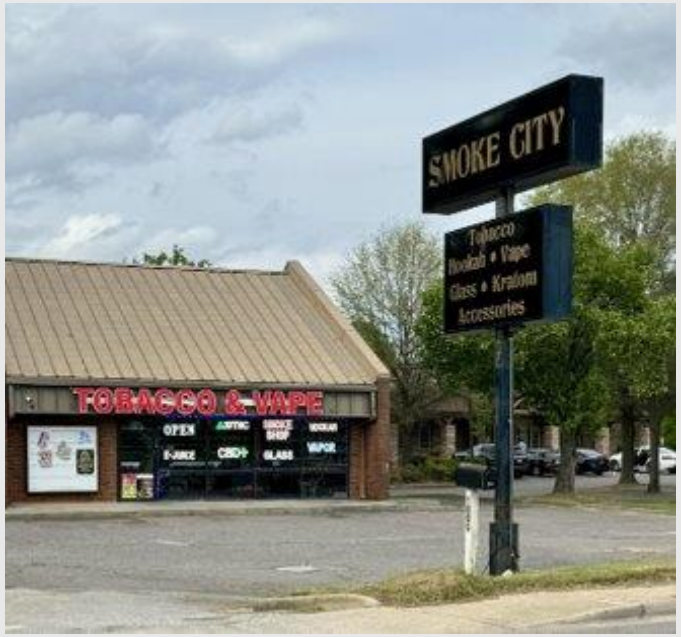


Photo credit: Elizabeth Wilkes

Continued:

Photo credit: Elizabeth Wilkes

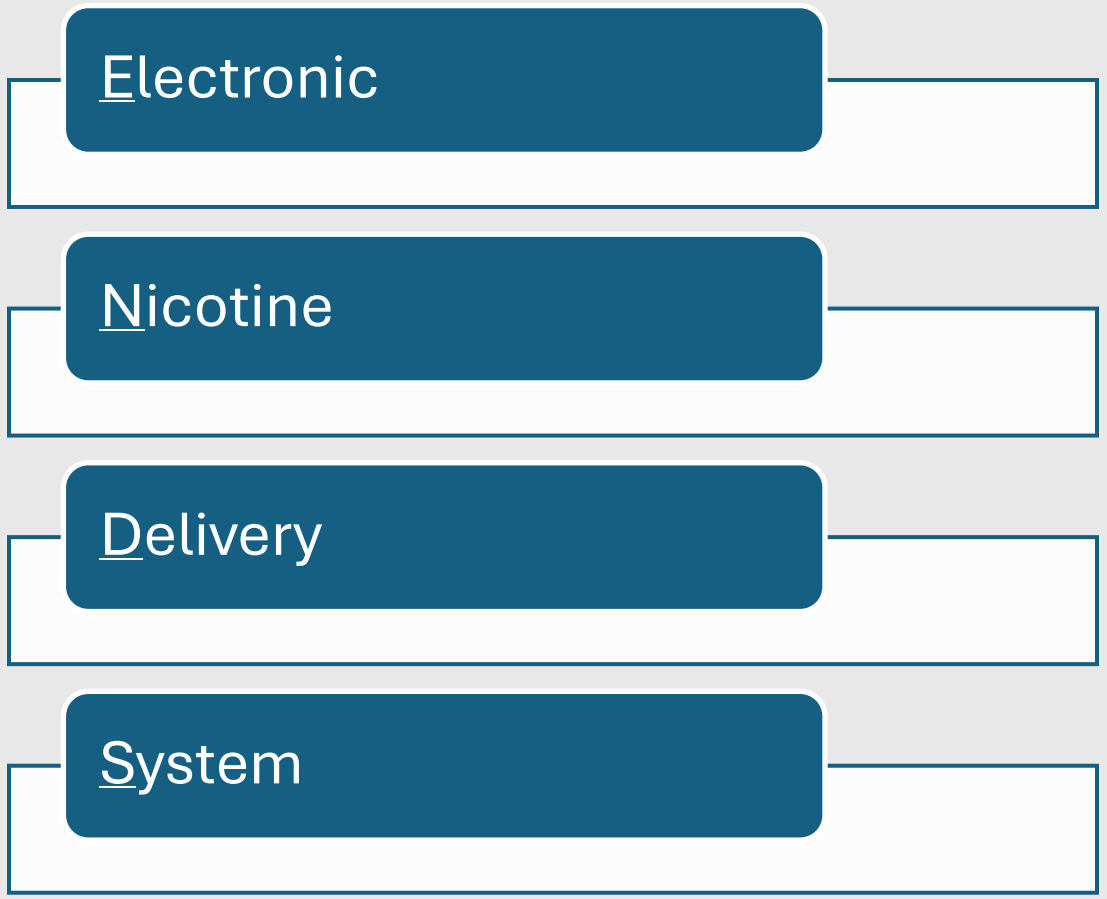
Continued again!

Photo credit: Elizabeth Wilkes

Vaping Definitions, History, and Prevalence

ENDS—What is it?

- Known as an electronic or e-cigarette
- Device that produces an aerosol or vapor
- This vapor is inhaled by the user
- The act of using an e-cigarette is termed “Vaping”
- People who use e-cigarettes are referred to as ”Vapers”
- ENNDS: Electronic Non-Nicotine Delivery Systems are also used



History of Electronic Cigarettes

1927

Joseph Robinson filed a patent for an electronic cigarette

- Never commercialized or manufactured

1965

Herbert A. Gilbert—the "Smokeless"

- First noncombustible cigarette prototype
- "Steam without nicotine"

1986

Favor Cigarette

- Sold in California, other states only where smoking was banned

https://www.smithsonianmag.com/innovation/plans-for-first-e-cigarette-went-up-in-smoke-50-years-ago-180970730/

https://cigarettecollector.net/2017/04/04/favor-smokeless-cigarettes-regular-vintage-american-cigarette-pack/

Hon Lik Launches a New Era (2003)

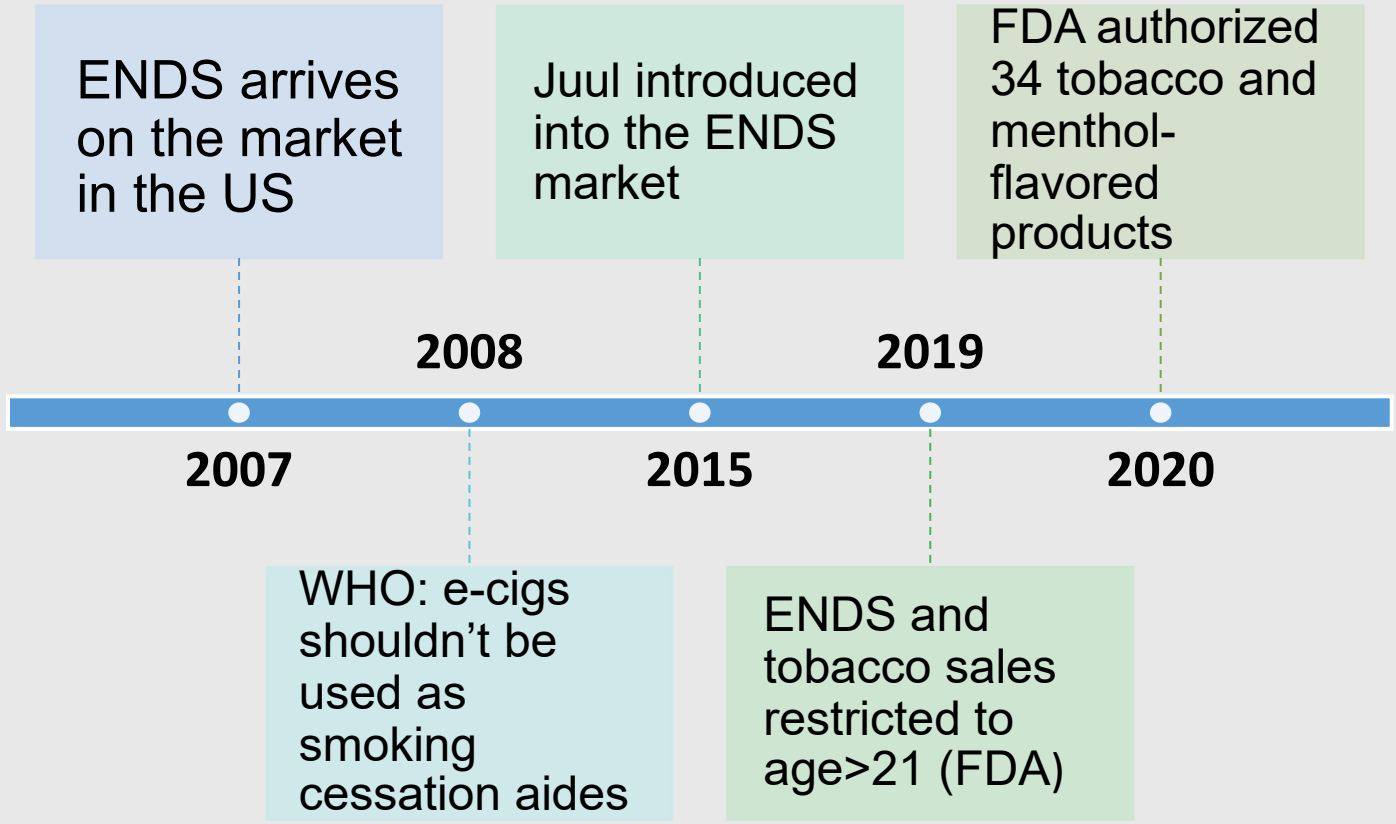
- Chinese pharmacist and inventor
- Started smoking at age 18
- Father passed away from lung cancer
- Idea: create a harmless alternative to traditional cigarettes
- First patent in China

https://www.theguardian.com/society/2015/jun/09/hon-lik-e-cigarette-inventor-quit-smoking-dual-user

https://www.caferacervape.com/blogs/news/36962049-a-brief-history-of-e-cig-vape-design-and-evolution

2004: First Electronic Cigarette “Ruyan”

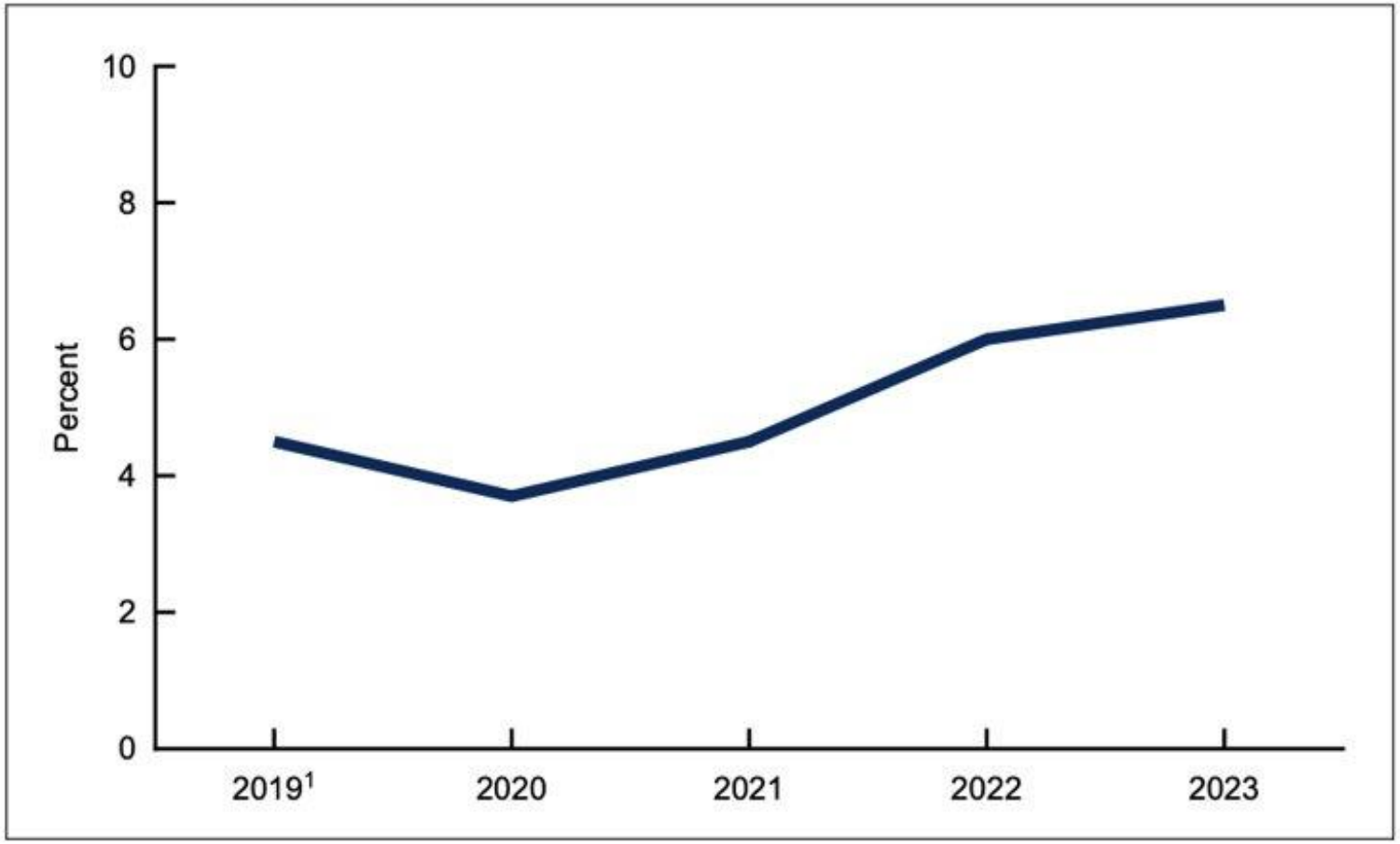
Notable Events in the History of E-Cigarettes



https://www.vapedensity.ca/juul-pods-1-8-4pods-pack.html#

How many people are vaping?

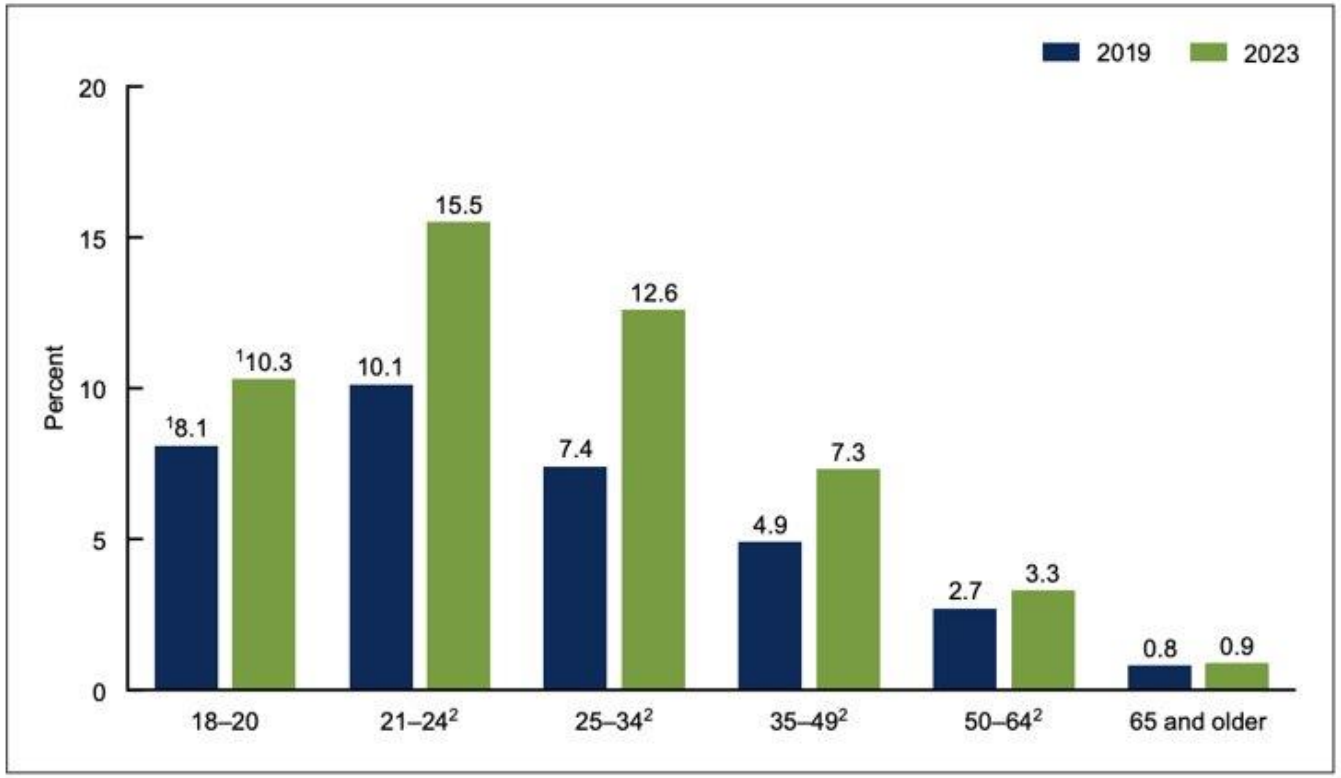
Figure 1. Percentage of adults who used electronic cigarettes: United States, 2019–2023



[1]Significant quadratic trend by year ($p < 0.05$).
NOTE: Estimates are based on household interviews of a sample of the U.S. civilian noninstitutionalized population.
SOURCE: National Center for Health Statistics, National Health Interview Survey, 2019–2023.

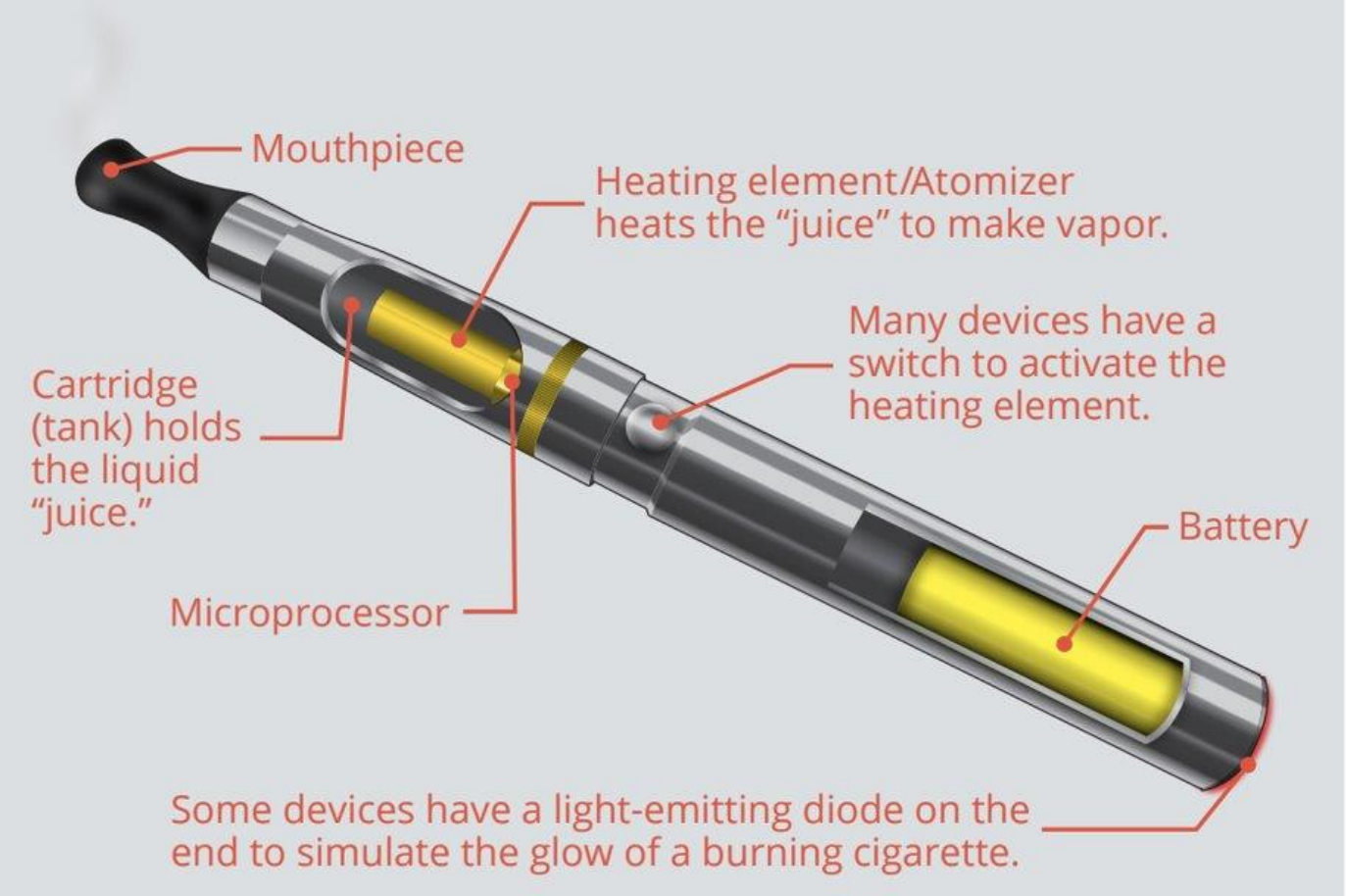
What's the age breakdown of e-cigarette users?

Figure 3. Percentage of adults who used electronic cigarettes, by age group: United States, 2019 and 2023



[1]Significant quadratic trend by age ($p < 0.05$).
[2]Significantly different by year ($p < 0.05$).
NOTES: In 2019, all pairwise comparisons were significant ($p < 0.05$), except comparisons between adults ages 18–20 and 21–24 and between adults ages 18–20 and 25–34. In 2023, all pairwise comparisons were significant, except comparisons between adults ages 18–20 and 25–34. Estimates are based on household interviews of a sample of the U.S. civilian noninstitutionalized population.
SOURCE: National Center for Health Statistics, National Health Interview Survey, 2019 and 2023.

Basic Anatomy of an ENDS



https://www.usfa.fema.gov/downloads/pdf/publications/electronic_cigarettes.pdf

1st and 2nd Generation ENDS

https://www.usfa.fema.gov/downloads/pdf/publications/electronic_cigarettes.pdf

3rd Generation ENDS: Tanks or Mods

https://www.usfa.fema.gov/downloads/pdf/publications/electronic_cigarettes.pdf

Pod Mods: 4th Generation ENDS

https://www.usfa.fema.gov/downloads/pdf/publications/electronic_cigarettes.pdf

How is Juul™ Different?

- Common Pod Mod that uses nicotine salts rather than free base nicotine
- Nicotine salts have a lower pH
- Higher levels of nicotine are inhaled more quickly
- Easy to use, draw activated
- Juul has run an aggressive marketing campaign targeting the younger generation

https://www.vapedensity.ca/juul-pods-1-8-4pods-pack.html#

E-liquid or E-juice

Primary Ingredients:

- Nicotine 0 to 36 mg/mL, but may be as high as 50 mg/mL
  - Standard cigarette contains 10 mg nicotine, 1-2 mg is absorbed when inhaled
- Solvent as a base
  - Propylene Glycol
  - Vegetable Glycerin

Other Ingredients Detected in E-juice

- Acetone
- Acrolein*
- 1,3-Butadiene (Diacetyl)
- Diethylene Glycol
- Cyclohexane
- Ethanol
- Formaldehyde
- N-nitrosonornicotine (NNN)
- Toluene*
- Metals such as Copper, Nickel, Lead, Tin, Cadmium, Magnesium, Zinc*
- 1 of over 7000 flavorings, such as Diacetyl*

E-cigarettes—An unintended illicit drug delivery system

Andreas K. Breitbarth[a], Jody Morgan[b,c,*], Alison L. Jones[b,c]

[a] *Illawarra Shoalhaven Local Health District, Wollongong, NSW, 2500, Australia*
[b] *Faculty of Science, Medicine and Health, University of Wollongong, Wollongong, NSW, 2522, Australia*
[c] *Illawarra Health and Medical Research Institute, University of Wollongong, Wollongong, NSW, 2522, Australia*

- 38 studies: e-cigarettes were used to vape illicit drugs
  - Most common: ***Cannabis***
- Prefilled cannabis cartridge sales in Colorado increased by 163% between 2015 and 2016 (legalized in 2012)
- Amount in e-liquid often exceeds amount shown on label

Other drugs used via vaping route:

- Synthetic Cannabinoids ("K2, Spice")
- Methamphetamines
- MDMA (Ecstasy)
- Cocaine
- Heroin
- Fentanyl

Deleterious Health Effects from ENDS

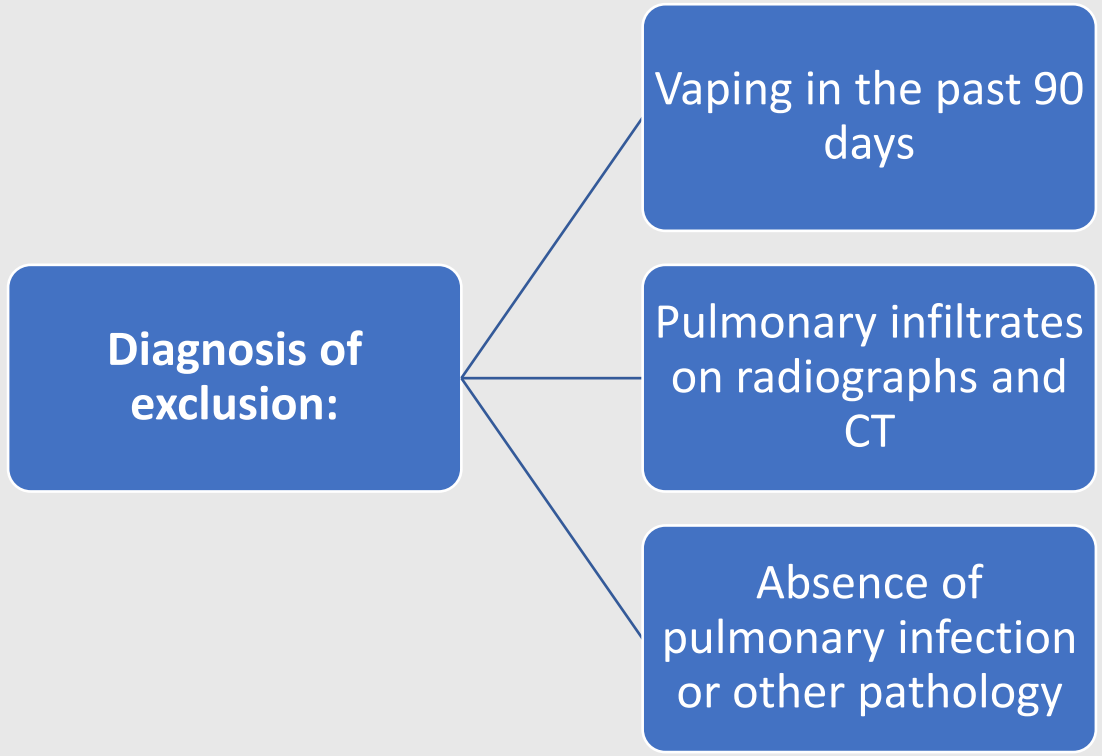
- Respiratory
- Oral Cavity and Poisoning
- Cardiovascular
- Sexual
- Immunologic
- Burns/Thermal Injuries

E-Cigarette Vaping Associated Lung Injury (EVALI)

https://abcnews.go.com/ABCNews/vaping-crisis-evali/story?id=66217454

https://www.cnn.com/2020/01/09/health/cdc-vaping-lung-injury-evali-teen-update-bn/index.html

EVALI



Signs and symptoms:

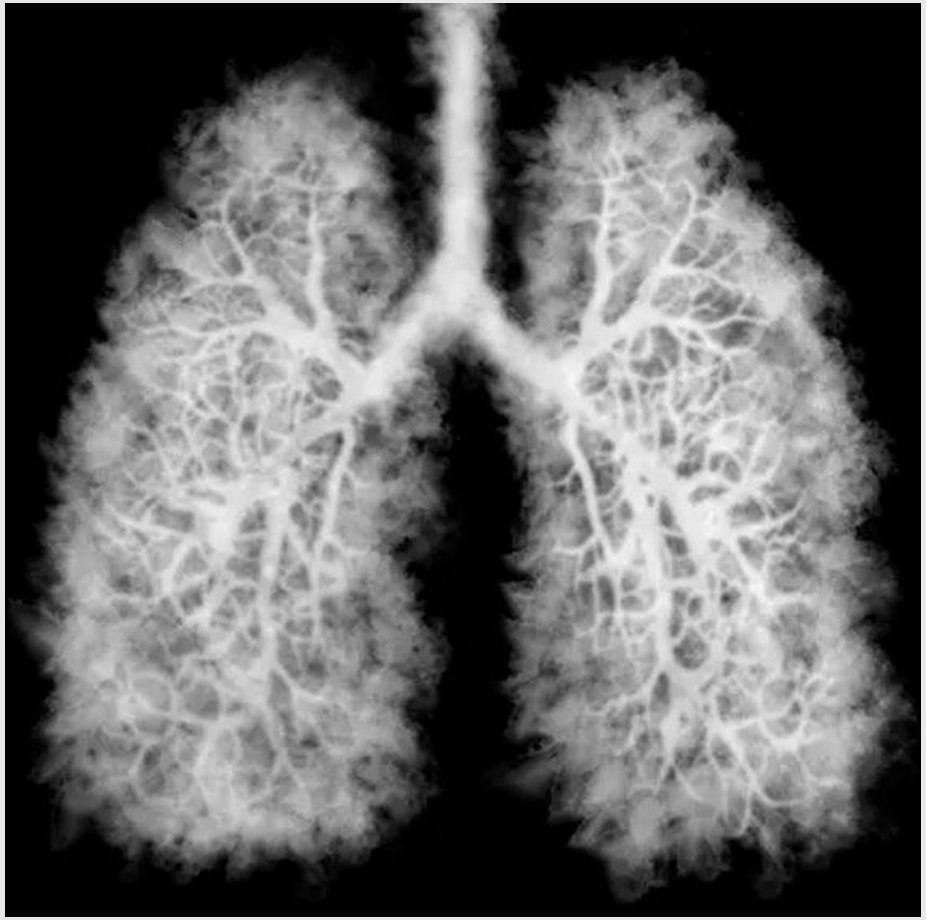
- Cough, chest pain, dyspnea, hemoptysis
- Tachypnea
- Hypoxia
- Tachycardia
- Fever
- Rapid weight loss
- GI: Nausea/vomiting, abdominal pain, diarrhea

EAVLI, continued

•Injury is consistent with toxic or chemical lung injury, pneumonitis, pneumonia, and alveolar damage

•Vitamin E Acetate and THC from unregulated sources were linked to EVALI—”Dank Vapes”

•Vaping > 5 times/day



https://www.medpagetoday.com/pulmonology/smoking/90294

Bronchiolitis Obliterans

- From the flavoring **Diacetyl**

- Symptoms:
  - Coughing
  - Wheezing
  - Shortness of Breath
  - Dry throat

Popcorn Lung

One Recent Headline...

High School Cheerleader Left with 'Deadly Diagnosis' After Secretly Vaping for 3 Years

Brianne Cullen, 17, landed in the hospital with "popcorn lung," a chronic, irreversible condition

By Cara Lynn Shultz | Published on April 9, 2025 04:10PM EDT

Brianne Cullen, 17, landed in the hospital with an irreversible lung condition from vaping.
Credit : Kennedy News & Media

A systematic review examining the pulmonary effects of electronic vapor delivery systems

Corinne E. Novelli, DNP, CRNA [a], Elizabeth J. Higginbotham, DNP, CRNA [a], Karen A. Kapanke, DNP, CRNA [b], Kashica J. Webber-Ritchey, PhD, MHA, RN [c], Christopher H. Parker, PhD, MS [d], Shannon D. Simonovich, PhD, RN [c,*]

2022, 38 studies

Identified 6 ENDS-induced pulmonary derangements

1) Changes in Pulmonary Function Tests (PFTs)-- FEV1, FEV1/FVC
2) Disrupted ventilation/gas exchange
3) Impaired mucociliary clearance
4) Tissue destruction
5) Disrupted immune response
6) Oxidative stress with DNA fragmentation

Heavy Metal Inhalation

- Iron
- Copper
- Magnesium
- Zinc
- Nickel
- Cadmium
- Chromium
- Lead

Heavy Metals and the Oral Cavity

Detrimental effects for development of periodontal disease

Increased oxidative stress and inflammatory cytokine release

- Gingival recession, bone loss

Increased levels of TNF-a and IL-B

- Dental implant failure

Tooth loss, oropharyngeal cancer

E-liquid Ingestion and Poisoning

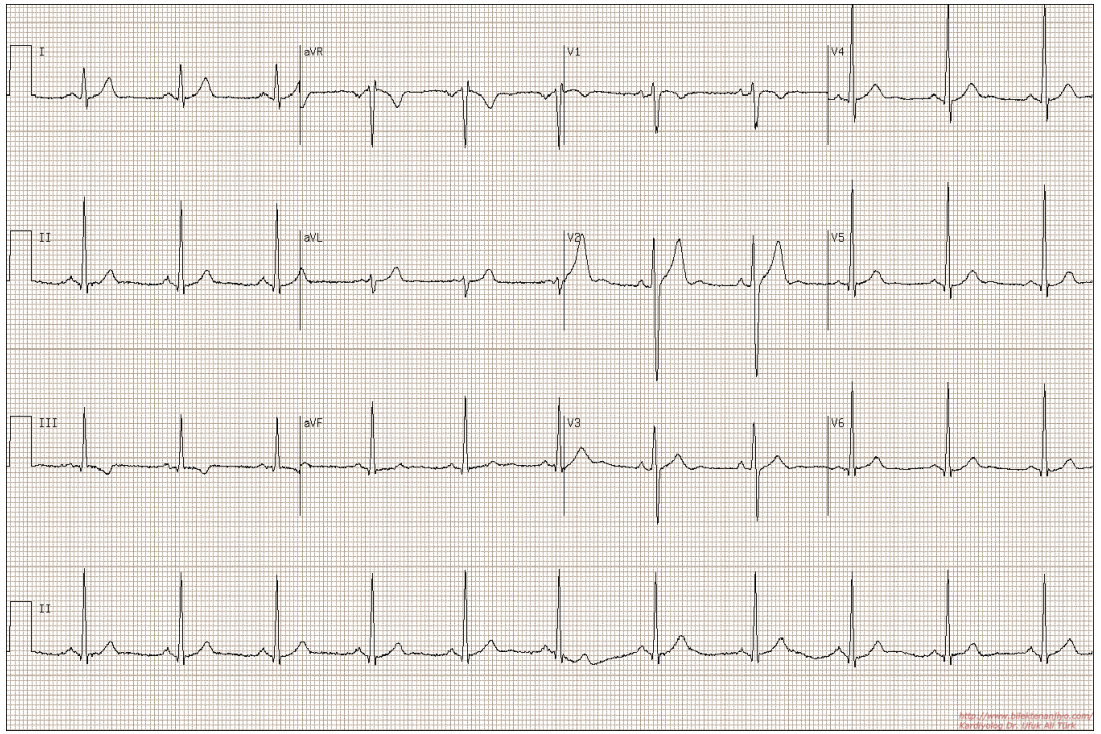
- Accidental or intentional ingestion can cause severe poisoning, including nicotine poisoning
- 2018-19 1555 cases of children< 5 years old ingesting e-liquids
- Ingesting less than ¼ teaspoon of 1.8% concentrated liquid nicotine can be fatal to a 50-lb child (Children's Safety Network)

Cardiovascular Effects from ENDS

Nicotine binds to nicotinic cholinergic receptors

<u>CNS stimulant that enhances the release of catecholamines</u>

Tachycardia	Systolic and Diastolic BP	Increased myocardial oxygen consumption



E-Liquid Component: *Acrolein*

- Increase in platelet activation→thrombotic events
- When inhaled long-term, Acrolein inhibits circulation of endothelial progenitor cells
- Progenitor cells are involved in repairing blood vessels
- Result: atherosclerosis and hardening of the arteries
    - ***Hyperlipidemia, Insulin Resistance, MI***

A chronic e-cigarette user has a 1.7 times greater chance of sustaining a myocardial infarction over the course of their lifetime!

Another Recent Headline…

24-Year-Old Suffers Heart Attack After Years of Vaping, Now Feels Like He's 'Breathing Through a Straw'

Jacob Temple is warning people about the health consequences of e-cigarettes, saying he now has the lungs of a 70-year-old

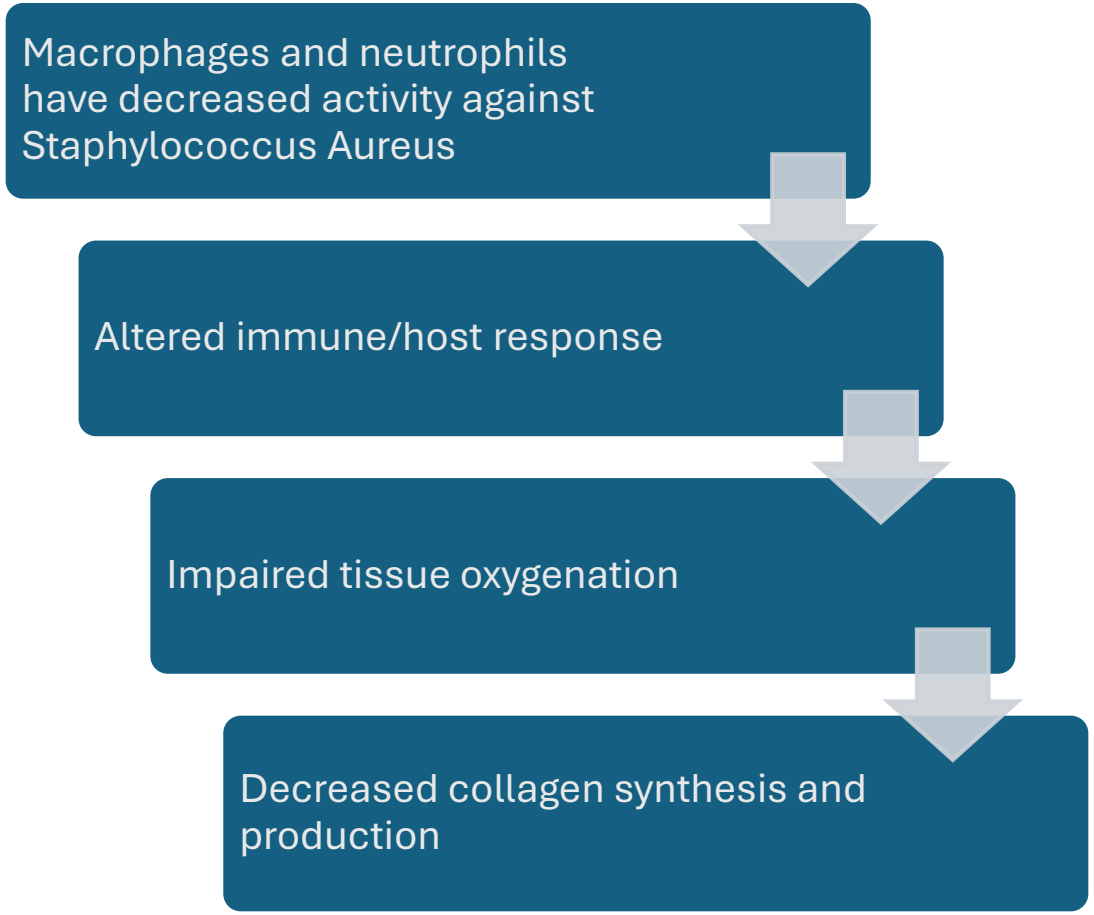
By **Jillian Frankel** | Updated on June 30, 2025 04:35PM EDT

https://people.com/vaping-led-man-24-year-old-heart-attack-11760085

Erectile Dysfunction

- Twice as many men use e-cigarettes compared to women
- Elevated nicotine from vaping impairs vasodilation and reduces penile circulation
- E-liquids with or without nicotine reduces circulating testosterone levels

Immunologic effects from ENDS use



Surgical Site Infections????

The Surgical Impact of E-Cigarettes: A Case Report and Review of the Current Literature

Megan Fracol[1], Robert Dorfman[1], Lindsay Janes[1], Swati Kulkarni[2], Kevin Bethke[2], Nora Hansen[2], John Kim[1]

- 2017
- 51-year-old female with right breast cancer
  - bilateral mastectomy with immediate tissue expander reconstruction
- 25 pack year smoking history who quit 3 months prior to surgery

3 Weeks Postoperatively:

Bilateral skin flap necrosis

- Tissue expander removal and debridement

Upon questioning patient, she revealed she was an active ENDS user

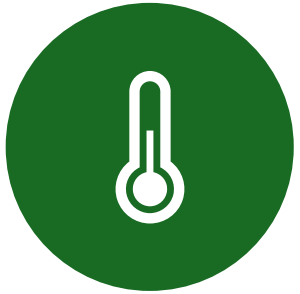
- ~ Previous 1.5 PPD amount

Patient believed they were safer than traditional cigarettes

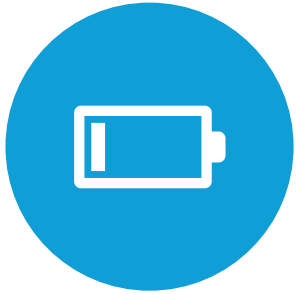
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5801784/

Burn/Thermal Injuries from ENDS

Thermal or chemical burns, full-thickness to explosion trauma



Heating coil in the vaporizing chamber heats the e-liquid to temperatures from 100-300 degrees Celsius



Lithium-Ion battery can short-circuit, overheat, or explode

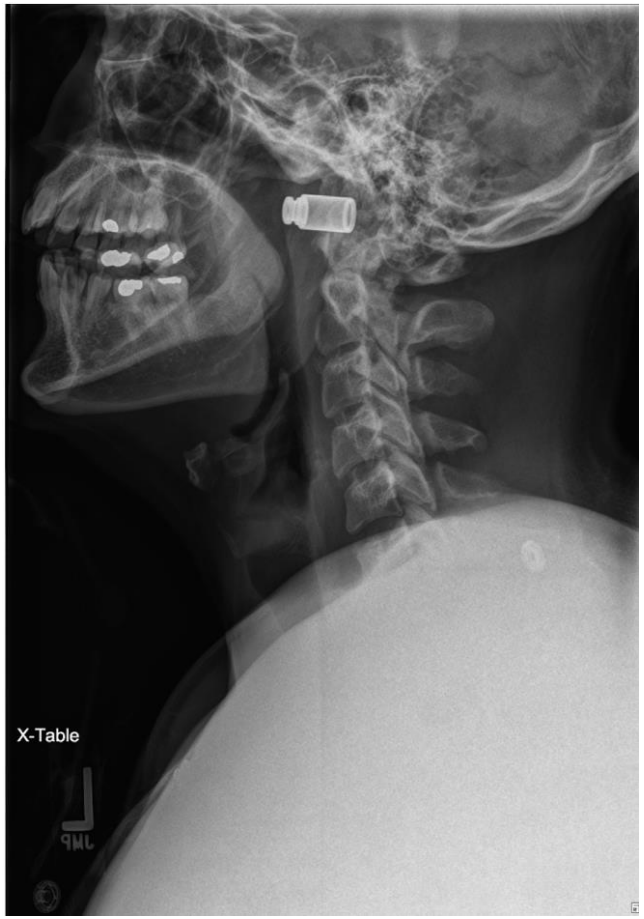
Most common sites of injury: thigh and hand

Burn/Thermal Injuries

The Journal of Pediatrics 2018 196320-320.e1DOI: (10.1016/j.jpeds.2017.12.032)

Kite, A. C. , Le, B. Q. , Cumpston, K. L. , Hieger, M. A. , Feldman, M. J. & Pozez, A. L. (2016). Blast Injuries Caused by Vape Devices. *Annals of Plastic Surgery, 77* (6), 620-622. doi: 10.1097/SAP.0000000000000875.

Electronic Cigarette Explosion Resulting in a C1 and C2 Fracture: A Case Report
Norii and Plate (2016)



27-year-old male

E-Cigarette exploded during use

Mouthpiece lodged in oropharynx and C1 vertebrae

C1 and C2 fractures

Removal of foreign body in OR

Patient recovered without neurologic deficit

https://www.sciencedirect.com/science/article/pii/S0736467916306667

What about our pediatric and adolescent patients?

Nicotine and Marijuana affect brain development in young adults

Negatively impacts attention, learning, mood, and impulse control

Vaping increases the likelihood of abuse/misuse later in life

Anesthesia Considerations in the Patient Who Vapes

No definitive guidelines exist for anesthetic management of the patient who uses E-cigarettes!

Preoperative Consideration #1

Thorough examination of ENDS use:

1. How much do you vape?
2. How long have you been vaping?
3. What do you vape?

Research Article | Short Report

A Survey Assessing the Vaping Habits of Patients Undergoing Surgery

Max M Feinstein, Ira Schlosberg, Sigal Israilov, Matthew Sison and Daniel Katz

Respiratory Care October 2022, 67 (10) 1332-1334; DOI: https://doi.org/10.4187/respcare.09830

- Survey of ages 18-75
- Administered to patients in the preoperative area of Mount Sinai Hospital (NY)
- July-November 2020
- 36 of 199 respondents admitted to ever vaping (18.1%)
- 49 of 119 (41.2%) did not assume that vaping was included in smoking

Preoperative Consideration #2: Optimize!

- Education to avoid E-Cigarette use the day of surgery
    - Encourage cessation of ENDS use
- Long-standing ENDS user→consider:
    - Chest radiographs
    - PFTs
    - Baseline ABG
    - EKG
    - Echocardiogram
- Obtain Platelet count and Coagulation studies if needed

Day of Surgery/Immediate Preoperative Period

Possible PO corticosteroids in moderate to severe obstructive lung disease

May need subcutaneous Heparin

Pretreatment w short-acting Beta-adrenergic agonist

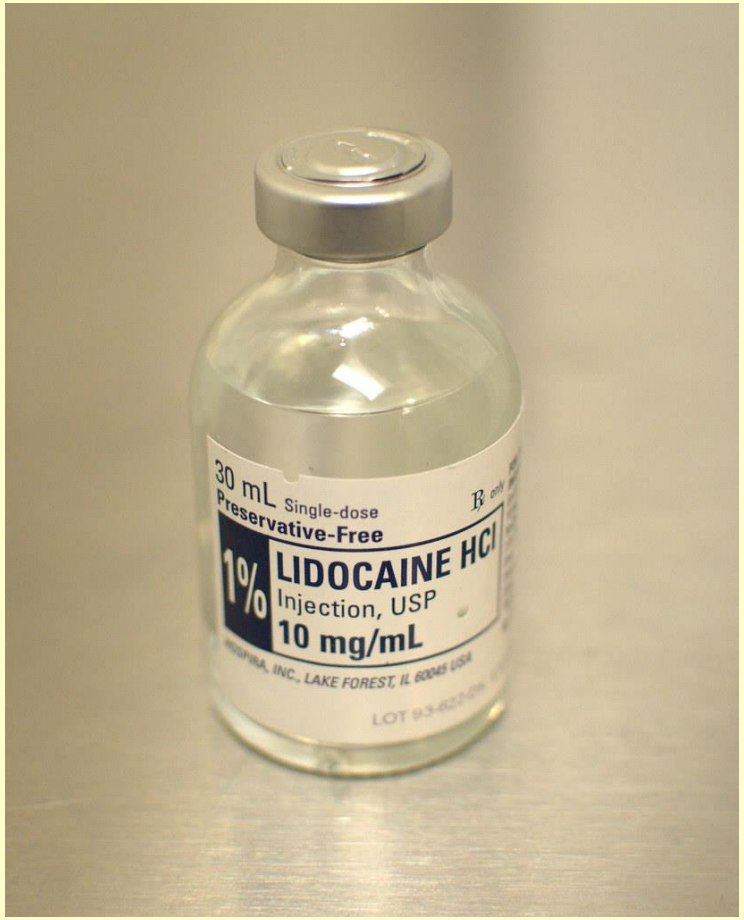
- 2-4 puffs Albuterol inhaler
- Albuterol 2.5 mg nebulizer 20-30 minutes prior to airway manipulation

Antisialagogue to dry secretions

Adequate premedication to decrease patient anxiety and improve work of breathing

Intraoperative Considerations: Induction

- Thorough pre-oxygenation
- IV Lidocaine to avoid laryngospasm
- Consider LTA
- Avoid airway manipulation during light anesthesia



Intraoperative Considerations: Maintenance & Volatile Agents

Sevoflurane is preferred

- Avoid Desflurane

Tendency towards airway reactivity and bronchospasm

Emergent cases may require less inhalational agent

- ***Toluene***

Intraoperative Considerations: Opioids and Neuromuscular Blockers

- Patient may require higher doses of opioids
  - Research still limited in this area
  - Chronic nicotine exposure in both EC and traditional cigarettes increases the patient's risk of developing chronic pain postoperatively
  - Abstinence for 1 day can result in hyperalgesia after surgery

- Monitor neuromuscular blockade
  - More frequent dosing

Intraoperative Considerations: Oxygenation and Ventilation

- Anticipate hypoxemia
- Bronchodilators (Albuterol) if needed
- Have Epinephrine on standby
- Patient spirometry may show an obstructive pattern
- Consider ABG in a long case

Maintenance, continued

Anticipate hemodynamic instability

Tighter HR and BP control

Judicious dosing of Ephedrine/Phenylephrine

Intraoperative Considerations: Emergence

- E-Cigarettes effect on PONV unknown
- Consider deep extubation
- Watch for exaggerated hemodynamic responses

Teens, Adolescents, and Young Adults:

Consider the 3rd molar extraction

- One of the most common outpatient surgeries performed in the 2nd and 3rd decades of life

Orthopaedic surgery

- Increased risk for venous thromboembolism

Conclusion: Why should I care as an anesthesia provider?

We have an obligation to be familiar with the physiologic implications of vaping products!

- The use of vaping products is increasing and unlikely to decrease
- Public health crisis
- Potential to contribute to significant morbidity worldwide
- Patients who vape may be more at risk for respiratory, cardiovascular, immunologic, CNS, and wound healing problems during and after an anesthetic
- Long-term effects of vaping still largely unknown

References

- Banks, E., Yazidjoglou, A., Brown, S., Nguyen, M., Martin, M., Beckwith, K., Daluwatta, A., Campbell, S., & Joshy, G. (2023). Electronic cigarettes and Health Outcomes: Umbrella and systematic review of the global evidence. *Medical Journal of Australia*, *218*(6), 267–275. https://doi.org/10.5694/mja2.51890
- Breitbarth, A. K., Morgan, J., & Jones, A. L. (2018). E-cigarettes—an unintended illicit drug delivery system. *Drug and Alcohol Dependence*, *192*, 98–111. https://doi.org/10.1016/j.drugalcdep.2018.07.031
- Bulat, E., Komlan, A.-G., Bonaparte, C., White, R., & Jotwani, R. (2022). Perioperative considerations of patient e-cigarette use for the anesthesiologist. *Journal of Clinical Anesthesia*, *78*, 110619. https://doi.org/10.1016/j.jclinane.2021.110619
- Cutts, T. G., & O'Donnell, A. M. (2021). The implications of vaping for the Anaesthetist. *BJA Education*, *21*(7), 243–249. https://doi.org/10.1016/j.bjae.2021.02.001
- FDA. (n.d.). *E-cigarettes, vapes, and other ends*. U.S. Food and Drug Administration. https://www.fda.gov/tobacco-products/products-ingredients-components/e-cigarettes-vapes-and-other-electronic-nicotine-delivery-systems-ends
- Feinstein, M. M., Schlosberg, I., Israilov, S., Sison, M., & Katz, D. (2022). A survey assessing the vaping habits of patients undergoing surgery. *Respiratory Care*, *67*(10), 1332–1334. https://doi.org/10.4187/respcare.09830
- Fracol, M., Dorfman, R., Janes, L., Kulkarni, S., Bethke, K., Hansen, N., & Kim, J. (2017). The surgical impact of e-cigarettes: A case report and review of the current literature. *Archives of Plastic Surgery*, *44*(06), 477–481. https://doi.org/10.5999/aps.2017.00087

References (2)

- Harris, D., & Foley, E. (2020). Anesthesia Implications of Patient Use of Electronic Cigarettes. *American Association of Nurse Anesthesiology*, *88*(2).
- Heller, Z. A., Adlesic, E. C., & Portnof, J. E. (2022). Implications of electronic cigarettes on the safe administration of Sedation and general anesthesia in the outpatient dental setting. *Anesthesia Progress*, *69*(2), 41–52. https://doi.org/10.2344/anpr-69-02-16
- Hobson, A., Arndt, K., & Barenklau, S. (2020). Vaping: Anesthesia Considerations for Patients Using Electronic Cigarettes. *American Association of Nurse Anesthesiology*, *88*(1).
- Kallurkar, A., Kaye, A. D., & Shekoohi, S. (2024). Marijuana use, vaping, and preoperative anesthetic and surgical considerations in clinical practice. *Anesthesiology Clinics*, *42*(1), 53–63. https://doi.org/10.1016/j.anclin.2023.09.001
- Kite, A. C., Le, B. Q., Cumpston, K. L., Hieger, M. A., Feldman, M. J., & Pozez, A. L. (2016). Blast injuries caused by Vape Devices. *Annals of Plastic Surgery*, *77*(6), 620–622. https://doi.org/10.1097/sap.0000000000000875
- Lemay, F., Baker, P., & McRobbie, H. (2020). Electronic cigarettes: A narrative review of the implications for the pediatric anesthesiologist. *Pediatric Anesthesia*, *30*(6), 653–659. https://doi.org/10.1111/pan.13885
- Novelli, C. E., Higginbotham, E. J., Kapanke, K. A., Webber-Ritchey, K. J., Parker, C. H., & Simonovich, S. D. (2022). A systematic review examining the pulmonary effects of Electronic Vapor Delivery Systems. *Journal of Clinical Anesthesia*, *82*, 110952. https://doi.org/10.1016/j.jclinane.2022.110952

References (3)

- Overbeek, D. L., Kass, A. P., Chiel, L. E., Boyer, E. W., & Casey, A. M. (2020). A review of toxic effects of electronic cigarettes/vaping in adolescents and young adults. *Critical Reviews in Toxicology*, *50*(6), 531–538. https://doi.org/10.1080/10408444.2020.1794443
- Rossheim, M. E., McDonald, K. K., Soule, E. K., Gimm, G. W., Livingston, M. D., Barnett, T. E., Jernigan, D. H., & Thombs, D. L. (2020). Electronic cigarette explosion/burn and poisoning related emergency department visits, 2018–2019. *The American Journal of Emergency Medicine*, *38*(12), 2637–2640. https://doi.org/10.1016/j.ajem.2020.08.017
- Rusy, D. A., Honkanen, A., Landrigan-Ossar, M. F., Chatterjee, D., Schwartz, L. I., Lalwani, K., Dollar, J. R., Clark, R., Diaz, C. D., Deutsch, N., Warner, D. O., & Soriano, S. G. (2021). Vaping and e-cigarette use in children and adolescents: Implications on perioperative care from the American Society of Anesthesiologists Committee on Pediatric Anesthesia, Society for Pediatric Anesthesia, and American Academy of Pediatrics Section on Anesthesiology and Pain Medicine. *Anesthesia & Analgesia*, *133*(3), 562–568. https://doi.org/10.1213/ane.0000000000005519
- Shore, B. J., Flaugh, R., Shannon, B. A., Curran, P., & Hogue, G. (2021). Preoperative considerations for teenagers undergoing orthopaedic surgery: VTE Prevention, Mental Health Assessment, vaping, and drug addiction. *Journal of Pediatric Orthopaedics*, *41*(Suppl 1). https://doi.org/10.1097/bpo.0000000000001764