# VAPING, JUULING, DABBING: A TOXIC CLOUD

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A Program of SSM Health Cardinal Glennon

## Disclosures

- No potential conflicts of interest or financial relationships to report.

## Learning Objectives

Upon completion, the participant will be able to:

- Discuss the current evidence as it pertains to the known and potential risks of electronic nicotine delivery.
- Identify the usage trends of electronic nicotine delivery among youth and other high risk populations.

GOAL

## Key Terms

- **E-cigarette, a.k.a. "electronic cigarette," "e-cig," "personal vaporizer (PV)," or "electronic nicotine delivery system (ENDS)":**
  - Battery-powered vaporizer which simulates tobacco smoking.[1]
  - Often resembles cigarettes, cigars or pipes
  - Delivers a vaporized propylene glycol/nicotine mixture into user's respiratory system as a vapor (instead of smoke).
  - The vapor comes from heating the mixture. When heated the cartridge that contains the liquid nicotine converts the contents into a vapor that the user inhales.

1 Caponnetto, P., Campagna, D., Papale, G., Russo, C., Polosa, R. (2014). The emerging phenomenon of electronic cigarettes. *Expert Review of Respiratory Medicine,* 6(1), 63-74. https://doi.org/10.1586/ers.11.92

## Key Terms

- **Vaping:** inhaling and exhaling the "vapor" produced by an electronic cigarette or similar device.
- **E-liquid:** aka "e-juice" usually a mixture of propylene glycol, glycerin, nicotine, and flavorings.[1] E-liquids as currently sold are a threat to small children because they are not required to be child resistant, and they come in candy and fruit flavors that are appealing to children.
- **Nicotine vs. Tobacco:** E-cigs do not contain tobacco, although they do use nicotine from tobacco plants.[2]
- **Exposure:** Term used to distinguish between poison center calls were someone is asking for information vs. someone has ingested, inhaled, or absorbed a product through the skin or eyes.

1 Grana, R., Benowitz, N., & Glantz, S. A. (2014). E-cigarettes: a scientific review. *Circulation*, *129*(19), 1972–1986. doi:10.1161/CIRCULATIONAHA.114.007667
2 O'Connor R.J. (2012). Non-cigarette tobacco products: what have we learnt and where are we headed?. *Tobacco Control 2012, 21, 181-190.* https://doi.org10.1136/tobaccocontrol-2011-050281

## A Little E-Cigarette History

- E-cigarettes were first invented in the 1960s , but first entered the market in China in 2003[1]
- They were patented internationally in 2007[2] and first introduced to the United States.
- E-cigarette sales have approached $2 billion in 2013 and are estimated to surpass $10 billion in 2017[3]
- As of early 2014, there were 466 brands and 7764 unique flavors of e-cigarette products[4]
- In 2016, the U.S. Surgeon General releases a report entitled, "E-Cigarette Use Among Youth and Young Adults"

1 Foulds, J., Veldheer, S., Berg, A. Electronic cigarettes (e-cigs): Views of aficionados and clinical/publichealth perspectives. *Int J Clin Pract (2011)65, 1037-1042.*
2 Bell, K., Keane, H., Nicotine control: E-cigarettes, smoking and addiction. *Int J Drug Policy. (2012)23, 242-247.*
3 Herzog, B., Gerberi, J. Equity Research: E-cigs revolutionizing the tobacco industry. *Wells Fargo Securities, LLC Equity Research Department, 2013.*
4 Zhu, S.H., Sun, J.Y., Bonnevie, E., Cummins, S.E., Gamst, A., Yin, L., Lee, M. Four hundred and sixty brands of e-cigarettes and counting: Implications for product regulation. *Tob Control (2014) 23(3), iii3-iii9.*

## Device Parts

Source: U.S. Fire Administration (2017) Electronic cigarette fires and explosions in the United States 2009-2016

## Device Evolution

First Generation: Cig-A-Like
Second Generation: Vape Pen
Third Generation: MODS
Fourth Generation: Pods

Source: American Lung Association, Inc. 2019

## Device Evolution Continued…

Source: ARuback, 2019/LWarnock, 2017

## JUUL

Source: LWarnock, 2019/TNoble, 2018/BBurge, 2018

## E-Liquid

Source: LWarnock, 2017

## Dripping

Dripping: involves vaporizing the e-liquid at a high temperature by dripping a couple of drops of e-liquid directly onto an atomizers coils and immediately inhaling the produced vapor.

Source: Krishan-Sarin et. al, 2017

## Marijuana

Why Vaporize Marijuana?

- Get higher, faster
- Limited odor
- Discretion and stealth vaping
- Perceived as healthier to smoking

Via Herb/plant material or marijuana waxes

G Pro Vaporizer – Dry Herb

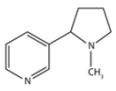
Source: O'Connor, 2018

## Dabbing

Source: LWarnock, 2017, O'Connor, 2018

## Nicotine

- Systemically absorbed from the lungs, skin and all parts of the GI tract
- Toxicity is dose related and occurs in two phases:
  - Initial stimulatory phase: Nicotine stimulates the ganglion-type nicotinic acetylcholine receptors in CNS and parasympathetic and sympathetic autonomic ganglia
    - Salivation, vomiting plus tachycardia and hypertension or vagal-mediated bradycardia
  - Secondary inhibitory phase: high concentrations of nicotine at the receptors then paralyzes them, so that ganglia do not transmit signals from brain to vasculature and other innervated tissues
    - Weakness, respiratory compromise and failure, death



Nicotine

Source: Nicotine Treatment Guideline, Missouri Poison Center 2016

## Nicotine Clinical Presentation

- CNS:
  - Dose related profession: headache, dizziness, lethargy, agitation, restlessness, delirium, coma, seizures.
- CARDIOVASCULAR:
  - Transient vasospasm-induced hypertension and tachycardia followed (in high doses) by hypotension and bradycardia.
- HEENT:
  - Miosis or mydriasis
- Neuromuscular:
  - High dose: Muscle fasciculations, hypotonia, decreased reflexes, muscle weakness, and paralysis.

Source: Nicotine Triage, Missouri Poison Center, 2016

## Nicotine Clinical Presentation cont.

- RESPIRATORY:
  - Tachypnea, dyspnea, and excessive secretions; followed in high dose exposure by respiratory depression and failure.
- GASTROINTESTINAL:
  - Sharp burning occurs in the mouth and throat on contact, followed by profuse salivation, nausea, vomiting, abdominal pain, and occasionally diarrhea
  - **Nausea and vomiting are the initial symptoms in all significant exposures.**
- DERMAL:
  - Intense diaphoresis due to sympathetic stimulation.
  - Excessive dermal absorption of nicotine may result in systemic effects.
  - Direct contact by nicotine liquid of e-cigarettes may cause erythema/rash.

Source: Nicotine Triage, Missouri Poison Center, 2016

## Nicotine Kinetics

- Nicotine undergoes >80% first-pass hepatic metabolism
- Half-life averages < 1-2 hours
- Mild toxicity rapidly resolves in 1 to 4 hours; duration is 18 to 24 hours with severe toxicity.

Source: Nicotine Triage, Missouri Poison Center, 2016

## Nicotine

| Tobacco/Nicotine Product | Average Nicotine Content per Unit | Route of Absorption and Peak |
|---|---|---|
| Cigarette | 10-12 mg per average cigarette | Oral 30 minutes |
| Cigar | 50-225 mg or more (depends on size) | Oral 30 minutes |
| Smokeless Tobacco | 10-12 mg per pinch | Oral and oral mucosa 20-30 minutes |
| Electronic Cigarette Solution | Usually 0-36 mg/mL up to 100 mg/mL by wholesale<br>• E-cig cartridge holds 0.3-1.6 mL<br>• Refill bottles hold 10-100 mL | Oral and Dermal 30 minutes |

Source: Nicotine Triage, Missouri Poison Center, 2016

## Nicotine Range of Toxicity

- 1 to 2 mg/kg orally may cause nausea, vomiting and other mild symptoms in children and naïve adults.
- >2-3 mg/kg may cause significant signs and symptoms of toxicity.
- >7-10 mg/kg is potentially life threatening.

Source: Nicotine Triage, Missouri Poison Center, 2016

## Nicotine in Perspective…

24 mg/ml of Nicotine in this bottle

2-3 mg/kg of Nicotine causes significant signs and symptoms

3 year old=13 kg

Toxic Dose: 13 kg x 2 mg/kg=26 mg (just over 1 ml would be toxic to this child)

10 ml refill bottle x 24 mg concentration = 240 mg of nicotine

Source: Nicotine Triage, Missouri Poison Center, 2016; Source: LWarnock, 2017

## Challenges with Determining Risks

- Determining health risks of e-cigarettes is a challenge due to several factors:
  - Type and voltage of e-cigarette device
  - Added flavorings
  - Battery power
  - Nicotine customization
  - Adulterants not listed on ingredients list
  - Toxicants formed during heating

Source: E-cigarette use among youth and young adults, A Report of the Surgeon General, 2016

## Puff Topography

- Puff duration among adult cigarette smokers who are <u>new</u> e-cigarette users are comparable to conventional cigarettes (2 seconds)
- Puff durations during e-cigarette use by <u>experienced</u> users are twice as long (4 seconds) as puff duration during conventional cigarette use.
  - This indicates that those who switch to e-cigarettes long term, may increase the duration of puffs resulting in more nicotine intake.

Source: E-cigarette use among youth and young adults, A Report of the Surgeon General, 2016

## Aerosolized Flavorants

It's the BIG UNKNOWN!

- More than 7,700 unique flavors are on the market
- Sweet and candy-like flavors are attractive to children
- Flavoring compounds are often undeclared on e-cigarette and e-juice packaging
- "Generally recognized as safe" in food but not tested for safety when heated or aerosolized

Source: E-cigarette use among youth and young adults, A Report of the Surgeon General, 2016/Photo Source: Source: LWarnock, 2017

## Aerosolized Adultrants

- Hazardous compounds and carcinogens have been detected in e-liquids or in the heated aerosol produced by e-cigarettes.
  - Formaldehyde, acetaldehyde, and acrolein
- High doses of fine particles (aerosol) are emitted.
- Toxic heavy metals may be a concern both from the aerosol and the device (i.e. atomizer/cartomizer)
- Many commercial and custom made e-liquids are produced with undisclosed manufacturing procedures, packaging materials, and purity standards.

Source: E-cigarette use among youth and young adults, A Report of the Surgeon General, 2016

## Nicotine and Dependence

- E-cigarettes have the potential to be at least equivalent to conventional cigarettes when it comes to dependence.
  - This is especially true with newer generation devices
- E-cigarettes likely deliver nicotine in sufficient doses and blood concentrations that would be expected to product and maintain dependence in among its users.

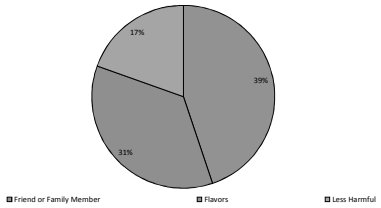
Source: E-cigarette use among youth and young adults, A Report of the Surgeon General, 2016

## Nicotine and Youth Users

- Since 2014, e-cigarettes have been the most commonly used tobacco product among middle and high school students
- 900% increase during 2011-2015 in e-cigarette use among U.S. middle and high school students
- By 2015-2017 first decline in use but by 2017 another 78% increase in use by high school students
- 1 in 5 high school students and 1 in 20 middle school students currently use e-cigarettes

Source: Surgeon General's Advisory on E-cigarette Use Among Youth, 2018

## Reasons for Youth E-cigarette Use




Source: American Lung Association

## Dependence in Youth

Teens who used e-cigarettes in the last month were about 7x more likely to report that they smoked cigarettes when asked 6 months later

**BUT**

The reverse was not true. Teens who smoked cigarettes were not more likely to report use of e-cigarettes at 6 months.

Source: National Institute on Drug Abuse, 2018

## Nicotine and Other Substances

- Youth who use nicotine are more likely to use other substances such as tobacco, alcohol and other drugs
- Young adults who smoke or use e-cigarettes are more likely to binge drink than non-smokers.

Source: Minnesota Department of Health, 2018

## Nicotine and Pregnancy

- "The evidence is sufficient to infer that at high-enough doses, nicotine has acute toxicity" and that "the evidence is sufficient to infer that nicotine adversely affects maternal and fetal health during pregnancy."
- "Nicotine can cross the placenta and has known effects on fetal and postnatal development. Therefore nicotine delivered by e-cigarettes during pregnancy can result in multiple adverse consequences including SIDS, and could result in altered corpus callosum, deficits in auditory processing, and obesity."

Source: Surgeon General's Report, 2014

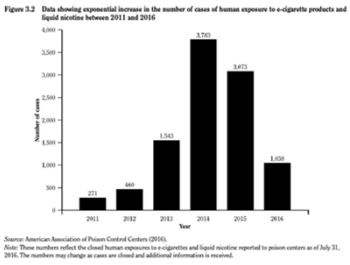
## Signs of E-Cigarette Use

- Sudden use of perfume/cologne
- Interest in burning candles
- Weight gain
- Irritability, anger, impatience, anxiety, hard time concentrating
- Increased thirst
- Nosebleeds
- Desire for flavor
- Cutting back on caffeine
- Pneumonia
- Missing phone chargers
- Finding unfamiliar USB drives, battery chargers or spare parts

Source: US News and World Report, 2018; CATCH my breath, 2019

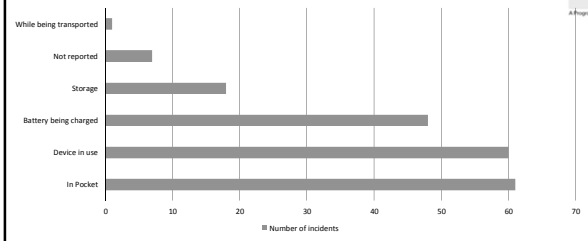
## Inadvertent Ingestions of E-Cigarette Liquid

- 51% of calls to poison c children <5 years of age
- As of June 30th, 2019 Pc nearly 2,100 cases invo nearly as many as in all
- Getting more Statistics




Source: AAPCC, 2016/Surgeon General's Report, 2014

## Explosions and Fires




Source: U.S. Fire Administration (2017) Electronic cigarette fires and explosions in the United States 2009-2016

## Second Exposure to E-Cigarettes

- Passive exposure to e-cigarettes causes and increase in serum cotinine similar to passive exposure from cigarette smoke
- Risk of allergic reactions in non-users such as dermatitis and allergic sensitization.
  - Several e-liquids contain flavorants derived from nuts

Source: E-cigarette use among youth and young adults, A Report of the Surgeon General, 2016

## Vaping in Popular Culture

- Vape is the 2014 Word of the Year for Oxford Dictionary
- Celebrities Vaping

## Vaping in Popular Culture

- Social Media Acceptance
- Vape Wear/Vape Concealment

## E-Cigarette Companies and Sales

- R.J. Reynolds (Camel)=VUSE
- Imperial Tobacco (Newport)= Blu
- Atria (Phillip Morris/Malboro) MarkTen

Source: CDC Newsroom, 2018/Tobaccofreekids.org

## Vaping Advertising

"**WARNING: This product contains nicotine. Nicotine is an addictive chemical.**"

## E-Cigarette Regulation

- Child Nicotine Poisoning Prevention Act of 2015
  - Requires liquid nicotine containers to be sold in child-resistant packaging consistent with U.S. Consumer Product Safety Commission

Source: AAP, 2015

## E-Cigarette Regulation

- FDA Deeming Regulations for E-cigarettes, Cigars, and All Other Tobacco Products
  - Extended FDA authority to all tobacco products including e-cigarettes.

| Previously Regulated by FDA | Now Also Regulated by FDA |
|---|---|
| • Cigarettes<br>• Cigarette tobacco<br>• Roll-Your-Own tobacco<br>• Smokeless tobacco<br>*This includes the components, parts, and accessories of these products.* | • Electronic Nicotine Delivery System (ENDS)<br>• Pipe Tobacco<br>• Cigars<br>• Hookah<br>• E-liquid<br>• Any other product that meets the definition of "tobacco product" under the FD&C Act, except accessories of newly regulated products.<br>*This includes the components and parts of these products.* |

Source: AAP, 2015/FDA.gov

## E-Cigarette Regulation

- FDA Deeming Regulations for E-cigarettes, Cigars, and All Other Tobacco Products
  - Banned sales under 18 years old
  - Photo ID for those under 27 years old
  - Banned free samples and vending machine sales
  - Warning statement on packaging

Source: AAP, 2015

## Public Policy Recommendations

- Reduce youth access to e-cigarettes.
  - a. The FDA should act immediately to regulate e-cigarettes similar to how traditional cigarettes are regulated to protect public health.
  - b. Ban the sale of e-cigarettes to children and youth younger than 21 years.
  - c. Ban Internet sales of e-cigarettes and e-cigarette solution.
- Reduce youth demand for e-cigarettes.
  - a. Ban all characterizing flavors, including menthol, in e-cigarettes.
  - b. Ban all e-cigarette product advertising and promotion in forms that are accessible to children and youth.
  - c. Tax e-cigarettes at comparable rates to those of conventional cigarettes.
- Incorporate e-cigarettes into current tobacco-free laws and ordinances where children and adolescents live, learn, play, work, and visit.

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

Source: AAP, 2015

## Who is serving you?

Advanced Practice Pharmacists & Nurses who are certified as Specialists in Poison Information, clinically supervised by a board certified physician toxicologist

## Poison Centers Manage **Demand**

- 90% of poisonings occur in the home.
- 70% of home calls to Poison Center are cared for <u>at home</u> by consultation and follow-up.
- Unnecessary visits to emergency rooms are avoided.

## Poison Centers Manage **Care**

- Poison Centers advise clinicians of clearly defined end points useful for decision-making and starting and stopping therapy in patients.
- A risk management **safety net** for the patient, the practitioner, and the Health Care Facility.

## Poison Centers Manage **Care**

- Poison Centers are often the first to catch contaminated food outbreaks or other public health crisis.
  - Response to the opioid crisis and counterfeit opioids
  - Contaminated K2 with brodifacoum

## A Call to Action…

Save the number as a contact in your phone:
Poison Help Line:
1-800-222-1222
Health Care Professionals
1-888-268-4195

## Questions?

MISSOURI POISON CENTER 1-800-222-1222

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