Vaping: Yes, Your Kid Knows Someone Who’s Doing it.
And Yes, Everyone is doing it.
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• I have the following to disclose:

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  Consultant - None
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  Stock - None

Objectives

• Review how we got here.
• Review Pulmonary complications with e-cigarettes/vapes
• Dealing E-cigarette/ Vaping in the clinic
• Discuss Nicotine Addiction & Options for treatment
• Review Resources available
Case 1

15-year-old young man arrives in ER in respiratory distress. Mother reports no significant past medical history. Exam is concerning for SpO2 85% on room air, cough, retractions and wheezing. He is started on continuous albuterol through BiPAP in PICU and has some improvement. Due to persistent dyspnea, Pulmonology is consulted. A chest CT scan is recommended.

Case 2


Over the past year, mother reports child has moving in & out her home to live with grandmother due to disagreements. He admits to poor adherence with medications including his ADHD medications. Denies any daily respiratory issues though mother disagrees reporting weight loss, decreased tolerance of activities of daily living, and increased cough. PFT trend is as shown.
Case 3

15 year old girl presented to ER with abdominal pain, vomiting. Vital signs significant for T: 38.5, RR 32, HR 120, SpO₂ 94% on room air. Physical exam: clear on inspiration; slight crackles on exhalation. Diffusely tender abdomen. Respiratory viral panel + Rhino/Entero. Abdominal film concerning for paucity of bowel gas and lead to a CT of abdomen. CT abdomen was concerning for bilateral ground glass opacities.
As of 2018, World Health Organization:
- More than 7 million people die annually due to tobacco-related diseases
- Smoking considered the 2nd most important risk factor
- Push to stop smoking from medical & cultural efforts

Emergence of E-cigarette
- Attempting to quit is difficult
  - Relapse within 8 days with no assistance
  - 3-5% prolonged abstinence of 6-12 months
- Addiction driven by multitude of behavioral smoking cues
- E-cigarettes proposed as a form of smoking cessation

Safety?

https://news.cancerresearchuk.org/2017/02/06/new-study-comes-the-closest-yet-to-proving-that-e-cigarettes-aren-3-dangerous-as-smoking/
Electronic Nicotine Delivery Systems (ENDS)

A rose by any other name?
- Vapes
- Vaporizers
- Vape pens
- Hookah pens
- Electronic cigarettes (e-cigarettes or e-cigs),
- E-pipes
- Mods
- Pots
- Carts

E-Cigarette
- Contains:
  - Plastic tube, Electronic heating component
  - Cartridge with liquid propylene glycol - With or without nicotine
  - Battery
- Heater activated → cartridge heated → liquid vaporized → smoke like aerosol inhaled.
- Disposable battery system or rechargeable
- Various flavors, nicotine levels

E-cigs vs Vapes
Differences & Similarities
- Flavor – less with E-cigs
- Limited battery life with E-cigs, less risk of burn
- E-cigs need new cartridges when they run out, mouth to lung hit
- Open Vape Pod Mod can be customizable in flavor, nicotine, direct to lung hit
- Closed Vape Pod Mod systems: disposable
- Vape Pens: can modify temperature, voltages, can modify mouth to lung or direct to lung hit

https://www.vaporplants.com/what-is-a-vape-pen
JUUL

- 2 components
  - Bottom – Battery, temperature regulation system
  - Top – E-liquid cartridge- also the mouthpiece
- Rechargeable – USB – laptop!!
- Discrete
- Took over the market in late 2010s

Differences:
- Not user modifiable
- Temp. regulation – prevent overheating and combustion
  - Less likely to burn or explode

What’s in it?

Vape Juice
- Water – vapor
- Vegetable Glycerin – sugar alcohol
  - Texture enhancer, boosts thickness
  - Also found in moisturizers
- Propylene Glycol
  - Tasteless, odorless, colorless
- Flavoring
- Nicotine

Juul Pod Juice
- Glycerol
- Propylene Glycol
- Natural oils
- Flavoring
- Nicotine
  - 5% Nicotine, 59 mg/mL per pod ~ content of a pack of cigarettes
- Benzoic Acid
- Extract Flavoring

Liquid Nicotine Chemistry

E-cigs & Vape Pens
- Freebase Nicotine
- Basic pH
- Throat irritation
- Limited tolerability
- Good stability

JUUL
- Nicotine salt
  - With Benzoic Acid
  - Acidic/Neutral pH
  - Smoother hit to throat
  - Increased tolerability
  - Improved stability
Nicotine and Adolescents

- Adolescent brains are evolving, responds to the world differently
- Prefrontal cortex used less often compared to adults:
  - PFC: planning, memory, organization, mood, judgement
  - Emotional information can be responded with a “gut reaction”
  - Adults are able to identify fear emotions more adequately than teens
  - Difficulty considering present day decisions with regard to the future
- Neurotoxic effect: prenatal nicotine disturbs balance of cholinergic transmission, behavioral/developmental effects
- Increased risk of addictive behaviors
- Vapor affects lung growth/function
  - Increased respiratory symptoms, chronic bronchitic symptoms

NPR Stories: Lifelong addiction

- Talked about vaping in high school
  - “...even after an hour and a half or two, I’m chomping at the bit to find my JUUL”
- JUUL Labs – “alternative to adult smokers, not anyone else, not minors”
- Flavors such as cotton candy, Frutti Tutti, cookies and cream, caramel, cherry, crème brulee
E-Cigarettes for Smoking Cessation

• NEJM: N = 886, E-cig or traditional nicotine replacement of their choice + Weekly behavioral support for at least 4 weeks
• Primary Outcome:
  • Sustained abstinence for one year
  • E-cig group: 18% 1 year abstinence rate; NRT group: 9.9%
• E-cig group - Mouth or throat irritation, but did use their assigned product more
• Meta-analysis looking at 38 studies:
  • More likely to remain off tobacco by 28%
  • More likely to stay addicted to E-cigs

Insufficient evidence to recommend as a way to stop smoking.


E-cigarettes: Gateway Effect

• Studies showing gateway effect with e-cigs preceding conventional cigarette use
  • Soneji, et al: 17389 14-30 yo. Odds Ratio: 3.62 CC use in those with hx of e-cig use,
    • Probability of cigarette smoking initiation was 35.4% for baseline e-cig users, 7.4% of never e-cig users.
    • Probability of smoking in the past 30 days: 21.5% for e-cig users, 4.6% for non
    • Baseline e-cig users more likely to use cigarettes.

E-cigarettes: Gateway effect

• Using E-cigs and progressing to smoking:
  • Chaffee, et al: Looked at 12-17 yo, and followed up in 1 year.
    • If using E-cigarettes, 2 x more likely to become an established smoker (>100 cigs), more likely to be a current smoker (smoked in the last 30 days) or be both.
  • If using E-cigarettes, more likely to continue cigarette smoking.
• In those who modified nicotine levels in vapes:
  • Golderson, et al: n = 181. Higher concentration of nicotine in e-cigarette, more likely to smoke more traditional cigarettes
  • More likely to use more cigs/ day.
Nicotine Levels

- E-Nicotine concentrations
- Cigarette varies: 8-20 mg per cigarette
- Juul Pod: 59 mg/mL ~ 1 pack

Abusing E-cigarettes

- E-cigarettes do not deliver carbon monoxide or other carcinogens
- Some really did use this as a way to reduce traditional cigarette use
- Users may "tamper" pods/juice
  - Increasing voltage delivers larger doses of nicotine
  - "Dripping": apply solution to heating element
  - Increases exposure to other chemicals
  - Can also mix different liquid solutions
    - Mix Alcohol
    - Mix THC

Vaping Illness Update: FDA Warns Public to Stop Using Tetrahydrocannabinol (THC)-Containing Vaping Products and Any Vaping Products Obtained Off the Street

FDA strengthens warning to public to stop using THC-containing vaping products and any vaping products obtained off the street.

- Do not use vaping products that contain THC.
- Do not use vaping products—particularly those containing THC—obtained off the street or from other illicit or social sources.
- Do not modify or add any substances, such as THC or other oils, to vaping products, including those purchased through retail establishments.
- No vaping product has been approved by the FDA for therapeutic uses or authorized for marketing by the FDA.
- No youth or pregnant women should be using any vaping product, regardless of the substance.
- Adults who do not currently use tobacco products should not start using these products.
- If you are an adult who uses e-cigarettes instead of cigarette smoking, do not return to smoking cigarettes.
Secondhand VAPE Exposure

- Not much out there; small studies.
- Compare to background and cigarette smoke exposures.
  - Articles from 1996 to 2015: Only 16/312 studies were relevant:
    - EC vapor compared to background levels: Increased nicotine, formaldehyde, propylene glycol.
    - EC vapor compared to cigarette smoke: Lower levels of every compound except nickel, silver.
  - One study looked at animal models (E Cig vs room air for 10 days) showed animals had decreased weight and lung growth.
  - 7 studies looked at human volunteers: more carbon monoxide, more volatile organic compounds, more nicotine.
  - 2 studies did not comment on possible exposure; then concluded that there was no risk to bystander, but these were funded by national vapors club.
Vaping pen Explosions

Acute Eosinophilic pneumonia

- 18 yo female
- Presented with cough, shortness of breath, chest pain, low oxygen
- Started vaping 2 months prior
- Blood count showed elevated white blood cells, 0.5% eosinophils
- CXR – possible pneumonia – started on antibiotics
- Had worsening saturations, respiratory distress
- Chest CT – patchy airspace disease and nodules
- Bronchoscopy: 26% eosinophils
- Treatment: HI dose IV Steroids

Arre et al. Acute eosinophilic pneumonia following electronic cigarette use. CF 2015; 16(10)
Bronchial Injury

- 35 year old female, non-smoker
- Came into ED with sudden onset chest pain and dyspnea
- Increased respiratory support despite normal Chest x-ray
- CT showed nodular infiltrates in the lower lobes, mediastinal adenopathy
- Admitted to e-cigarette use – equal to 2 packs/day cigarettes
- Mechanically ventilated with breathing tube, Extracorporeal Membrane Oxygenation
- Bronchoscopy: extensive airway trauma & thermal injury burns

What does the liquid break down to?
- Capable of heating liquid solutions to temperature 350°C
- Undergo conversion/breakdown from heating
  - Heating coils decompose to heavy metals (Manganese, Zinc)
  - Formaldehyde (5-15 times higher than in tobacco cigarettes)
  - Acetaldehyde, acetone, acrolein, propanal, butanal, glyoxal, methylglyoxal
  - Diacetyl – food flavoring (chemical that leads to popcorn lung)
  - Acrolein, formaldehyde, acetaldehyde – pulmonary irritants
    - Probable carcinogen, necrosis of living tissues
    - Propanal – pulmonary edema
    - Butanal – toxic pneumonitis
- Increased inflammation, makes mucus more sticky, impairs immune system defense.

Lipoid Pneumonia Outbreak – North Carolina
- July – August 2019: 5 pts in N. Carolina, 18-35 yo
- Increased shortness of breath, nausea, vomiting, abdominal pain, fever
- Increased respiratory rate, difficulty breathing, low oxygen levels
- Abnormal Chest x-rays
- All were electronic vaping pen/ e-cigs that were refillable with THC or nicotine, some also did cigarettes
- All 5 in hospital, 3 in ICU, 1 needed ventilator

Lipoid Pneumonia
E-cigarette or Vaping Associated Lung Injury

- Inflammatory response triggered by inhaled substances in e-cig/vape products
- Increased risk in those with THC containing products, Vitamin E acetate (others: triglycerides, plant oils, petroleum, diluent terpenes also found in lungs)
- Sx: dyspnea, cough, chest pain, fever, chills, N/V/Abdominal pain, tachyphnea, shallow breathing
- Dx: CT scan
- Trx: corticosteroids, supportive care
Survey finds higher risk of stroke among e-cig users

- Data collected by the 2016 Behavioral Risk Factor Surveillance System
  - Phone survey, sponsored by agencies like the CDC
  - All 50 states
  - Asks about risky behaviors; health issues
- Data collected by the 2016 Behavioral Risk Factor Surveillance System
  - 400,000 respondents
  - 66,795 reported using e-cigs at least once
  - Compared to non-users, E-cig (only) users had:
    - 71% higher risk of stroke
    - 59% higher risk of heart attack
    - 40% higher risk of heart disease
- Not submitted to a journal as of yet
- Problems:
  - Confounding variables – what other behaviors? Not prospective - More rigorous long term studies needed

Federal Response

- 2016: FDA expanded authority to include manufacture, import, packaging, labeling, advertising, promotion, sale, distribution of all tobacco products
  - Need to have healthy warnings on all ENDS
  - Prohibit sales to those <18 yo
  - Bans free samples and sales through vending machine
  - ENDS require marketing authorization
  - Vape shops that mix liquids must comply with legal requirements
- 2016: Child Nicotine Poisoning Prevention Act signed into law
  - Packaging safety standards, childproof packaging
- January 2020 – Flavor Ban
  - Cartridge based, except tobacco and menthol
  - Does not apply to tanks, mods, pens
  - Menthol ban: flavors still popular
- Menthol Ban proposal Summer 2022
- JUUL banned June 23, 2022 for sale in US. Repealed the next day.

National Youth Tobacco Survey: Flavor Types amongst middle/high school 2020

Middle School Student Trends

High School Student Trends
WHAT CAN I DO?

In the office...

Continue to rescreen at each visit

Screening

Intervention Education

Treatment

If Negative Screen,

If Negative Screen,

If starting treatment, Reassess & Educate at each visit

Screening

Don’t

• “Do you Smoke?”
  • Families do not consider vaping use as smoking.
• “Do you vape?”
  • No time frame allows omission by answering only about the present day
• Ask in front of family

Do

• “In the past year, you have used a tobacco, nicotine product such as cigarette, e-cigarette, vape?”
• Work on office flow to provide private time to screen
• Ask about friends & family smoking or vaping
• If acknowledged in the past, ask about frequency specifically
Difficulties with Interventions in Teens

- Jennsen et al. Looked at a large institution 300,000 pts
- EHR prompts to ask youth about tobacco use
  - 25 practices throughout CHOP
- May 2018 – August 2020 – 93,527 well visits for adolescents
  - 66,907 were screened for tobacco/e-cig use
  - 1603 (2.4%) reported use in the past year; 537 (0.8%) currently using
- Recruitment: 4382 emails sent
  - 52 referred; 15 enrolled, 18 unable to be contacted
  - 14 not interested, 5 ineligible
- 6 enrolled in the program.

Intervention/ Patient Education

- Directly combat misinformation
- Establish rapport
- Less authoritative

<table>
<thead>
<tr>
<th>Misconception</th>
<th>Educational Counter Argument</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;E-cigarettes are safer...&quot;</td>
<td>&quot;EVALI causing hospitalizations.&quot;</td>
</tr>
<tr>
<td>&quot;It's like inhaling water...&quot;</td>
<td>&quot;Water is never an ingredient...&quot;</td>
</tr>
<tr>
<td>&quot;Less second-hand smoke...&quot;</td>
<td>&quot;...aerosol which contains many particles, including heavy metals, chemicals...&quot;</td>
</tr>
<tr>
<td>&quot;...do not contain nicotine&quot;</td>
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<td>&quot;We don't know the long-term effects...&quot;</td>
<td>&quot;If short-term effects include serious illness, then long-term effects may be worse.&quot;</td>
</tr>
<tr>
<td>&quot;...will help you quit (traditional) cigarette smoking.&quot;</td>
<td>&quot;You're switching, not quitting.&quot;</td>
</tr>
<tr>
<td>&quot;But it's nicotine free...&quot;</td>
<td>&quot;Unflavored e-cigarette products cause airway damage at the cellular level.&quot;</td>
</tr>
<tr>
<td>&quot;We need to support small businesses.&quot;</td>
<td>&quot;Most of the popular e-cigarettes and products are owned by the original big tobacco companies, not small business owners.&quot;</td>
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In Office Treatment

- Provide counseling
- Assess readiness to quit & likelihood of success
  - Readiness to quit surveys
  - Assess support systems
  - Frequency of use, amount of nicotine
  - Use of other substances: marijuana/THC, conventional cigarettes, dabbing/waxing/huffing
- Assess access to use
- Discuss Options for Quitting
  - Cold Turkey vs Nicotine Replacement Therapy

Nicotine Replacement Therapies

- Nicotine Gum (Nicorette®)
- Nicotine Lozenges (Nicorette®)
- Transdermal patches (NicoDerm®)
- Nasal Spray (Nicorette®, Nicotrol NS®)
- Oral Inhaler (Nicotrol Inhaler®)
- Buproprion (Wellbutrin®, Zyban®)
- Varenicline (Chantix®)

Nicotine Replacement Therapies

- [Link to AAP download page](https://downloads.aap.org/AAP/PDF/NRT_and_Adolescents_Pediatrician_Guidance_factsheet.pdf)
- Resources for Nicotine Replacement therapies – Nice guide from AAP.
Nicotine Replacement Therapies


PHARMACOLOGIC PRODUCT GUIDE: FDA-Approved Medications for Smoking Cessation

Resources: Quitting

- N-O-T "Not On Tobacco": voluntary, small group tobacco cessation program through American Lung Association
  - [https://www.lung.org/quit-smoking/helping-teens-quit/not-on-tobacco](https://www.lung.org/quit-smoking/helping-teens-quit/not-on-tobacco)
  - Online version for teens: [https://notforme.org/](https://notforme.org/)
  - North American QuitLine Consortium: 1800-QUIT NOW or 1855 DEJELO-YA
- Texting program for smokers who want to quit; has a line for teens. [https://smokefree.gov/tools-tips/text-programs](https://smokefree.gov/tools-tips/text-programs)
  - SmokefreeTXT - QUIT to 47848 (Teens)

Resources: Institutional Resources

- AAP:
  - You can find a toolkit for presentations, review articles, Fact sheets for parents to provide in office and fact sheets for physicians.
- CDC
  - [https://www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease/healthcare-providers/index.html](https://www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease/healthcare-providers/index.html)
Resources: Youth Specific

- https://teen.smokefree.gov
- https://therealcost.betobaccofree.hhs.gov/
- https://myquitgov.com/
- https://truthinitiative.org/research-resources/topic/quitting-smoking-vaping

- Truth initiative: Text DITCHVAPE to 88709. Parents can text QUIT to 202-899-7550

References

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