The Evolution of Vaping Among Adolescents
Stacey Engster, MD, MS & Shannon Meyers, RN-BC

Objectives

1. To list the components of e-cigarettes and recent changes in product types
2. Discuss recent trends in adolescent e-cigarette use
3. To discuss the known and potential risks of e-cigarettes, vape devices, and JUUL
4. To describe methods to screen, counsel, and treat patients using e-cigarettes
Components of E-cigarettes

As Advertised
- Humectant
- Flavoring
- +/- Nicotine

As found
- Nicotine
- Ultrafine particles
- Toxicants
- Carcinogens
- Metallic nanoparticles (nickel, tin, and lead)
- Volatile organic compounds
- +/- psychoactive ingredients

Evolution of E-cigarettes

First Generation
- Similar to cigarettes ("cig-a-likes" or "minis")
- Disposable or rechargeable

Second Generation
- Vape pens and mid-sized e-hookah
- Refillable with e-liquid

Third Generation
- Modified Nicotine Delivery System (MODs)/Vape MODs
- Larger in size and battery capacity, rechargeable

https://www.centeronaddiction.org/e-cigarettes/recreational-vaping/what-parents-should-know-about-different-vaping-devices
1. One JUUL pod has the same amount of nicotine as one pack of traditional cigarettes.

True
**JUUL**

- Resembles USB flash drive
- Sleek design can be hidden from parents/teachers
- Rechargeable on a laptop or USB charger
- 5% nicotine = 59mg/mL vs 3% nicotine = 35mg/mL
- Flavors: Classic Tobacco, Menthol, Virginia Tobacco
- 1 cigarette = about 1mg nicotine (absorbed)
- 20 cigarettes per pack = 20mg nicotine
- JUUL pods contain 0.7mL of liquid
- 5% pod = 40mg nicotine = 2 packs cigarettes
- 3% pod = 23mg nicotine = 1 pack cigarettes

**www.juul.com**

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**JUUL sales rose exponentially between 2013 and 2018**

- BAT – Vuse
- Imperial - Blu
- Japan Tobacco– Logic, Ploom
- Altria – MarkTen, Green Smoke
- 35% JUUL stake

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Vaping Quiz

2. E-cigarette flavor does not affect how much or how often adolescents vape.

False
Flavorings

Use of e-cigarettes in nontraditional flavors (versus only tobacco, mint or menthol, or flavorless) was positively associated with vaping continuation (64.3% vs 42.9%; adjusted odds ratio = 3.76 [95% confidence interval 1.20 to 10.31]) and past-30-day number of puffs per nicotine vaping episode (mean: 3.1 [SD 5.5] vs 1.5 [SD 3.8]; adjusted rate ratio = 2.41 [95% confidence interval 1.08 to 5.92]) 6 months later.

JUUL Stopped Selling Nontraditional Flavors

• October 2019: JUUL stopped selling all flavors except mint, menthol, and tobacco

• November 2019: JUUL will only sell “Virginia Tobacco, Classic Tobacco and Menthol flavors in the United States.”
Practice talking to each of the following people about the components of e-cigarettes and recent changes in product types:

- Colleague
- Parent
- Adolescent

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4. To describe methods to screen, counsel, and treat patients using e-cigarettes
3. The number one reason adolescents report vaping is to relax or relieve tension.

False
TEEN VAPING CLIMBS SIGNIFICANTLY*

*Both Nicotine and Marijuana (THC)

**DAILY NICOTINE VAPING**
Measured for the first time in 2019

<table>
<thead>
<tr>
<th>Grade</th>
<th>8th graders</th>
<th>10th graders</th>
<th>12th graders</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.9%</td>
<td>6.9%</td>
<td>11.7%</td>
</tr>
</tbody>
</table>

**NICOTINE VAPING**
Past month use

<table>
<thead>
<tr>
<th>Year</th>
<th>8th graders</th>
<th>10th graders</th>
<th>12th graders</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>10.2%</td>
<td>15.0%</td>
<td>16.5%</td>
</tr>
<tr>
<td>2018</td>
<td>12.0%</td>
<td>16.9%</td>
<td>18.8%</td>
</tr>
<tr>
<td>2019</td>
<td>13.6%</td>
<td>18.9%</td>
<td>20.6%</td>
</tr>
</tbody>
</table>


2019 Past Month Vaping Rates for:
1 IN 4 – 12TH GRADERS   • 1 IN 5 – 10TH GRADERS   • 1 IN 10 – 8TH GRADERS

To view information on other drugs from the 2019 Survey visit:

TOBACCO AND NICOTINE: VAPING THREATENS PROGRESS

**NICOTINE – DAILY USE**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Daily Smoking</th>
<th>Daily Nicotine Vaping measured for the first time in 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>8th graders</td>
<td>0.8%</td>
<td>1.9%</td>
</tr>
<tr>
<td>10th graders</td>
<td>1.9%</td>
<td>6.9%</td>
</tr>
<tr>
<td>12th graders</td>
<td>2.4%</td>
<td>7.6%</td>
</tr>
</tbody>
</table>

**CIGARETTE SMOKING (PAST MONTH) DECLINES OVER PAST TEN YEARS**

<table>
<thead>
<tr>
<th>Year</th>
<th>8th graders</th>
<th>10th graders</th>
<th>12th graders</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>25%</td>
<td>20%</td>
<td>15%</td>
</tr>
<tr>
<td>2014</td>
<td>7%</td>
<td>5%</td>
<td>3%</td>
</tr>
<tr>
<td>2019</td>
<td>3%</td>
<td>2.3%</td>
<td>2.0%</td>
</tr>
</tbody>
</table>

*Significant decline from 2018 (3.6%)

*Significant decline from 2018 (7.6%)

TO VIEW MORE RESULTS ON VAPING VISIT:
4. The number of adolescents vaping THC decreased over the past year.  

False
Frequent Users are Increasing


Practice talking to each of the following people about the recent trends in adolescent e-cigarette use.

- Colleague
- Parent
- Adolescent
Objectives

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Vaping Quiz
True or False

5. Adolescents who use e-cigarettes are less likely to also use regular cigarettes.

False
E-cigarettes can lead to traditional cigarettes

Meta-analysis of 7 cohort studies
Adolescents and young adults are at higher risk of transitioning to traditional cigarettes
Adolescents and young adults aged 14-30 years who have used e-cigarettes are 3.6 times more likely to report using traditional cigarettes at follow-up


INITIATION AND CESSATION

Conclusion 16-1: There is substantial evidence that e-cigarette use increases risk of ever using combustible tobacco cigarettes among youth and young adults.

High Levels of Nicotine

- E-cigarettes can deliver higher levels of nicotine than traditional cigarettes.
- Pod system e-liquids (including JUUL) – can contain up to 59 mg of nicotine per mL!
- 63% of JUUL users do not know that the product always contains nicotine

www.juul.com
Nicotine Salts

- Nicotine salts = free base nicotine + benzoic acid
- Nicotine salts allow nicotine to be delivered at high concentrations without throat irritation
- Commonly called "Salt Nic"

Different Experiences By Users

Nicotine available per puff depends on:
- Temperature of atomizer
- How much juice atomized
- Size of atomized droplets
- Depth of the puff
- Concentration of e-juice

Wide variability in vaping behavior:
- Puff duration: 1.8 +/- 0.95
- Puff volume: 70 +/- 68 ml
- Puffs/session: 15+/- 6

E-cigarette Aerosols

- Inhalation of ultrafine particles deep into the lung
- Exposure to heavy metals in e-cigarette (nickel, lead, tin)
- Exposure to volatile organic compounds (benzene which is found in car exhaust)
- Chemicals linked to serious lung disease (diacetyl in flavorings)
- Still working to understand the health effects of these contents when heated and turned into aerosol for first and secondhand smoke

https://e-cigarettes.surgeongeneral.gov/knowtherisks.html#risks

6. The majority of people with e-cigarette vaping associated lung injuries (EVALI) report vaping THC products.

True
E-cigarette, or Vaping, product use Associated Lung Injury (EVALI)

- Symptoms:
  - cough, shortness of breath, or chest pain
  - nausea, vomiting, or diarrhea
  - fatigue, fever, or weight loss
- “No evidence of infectious diseases…lung illnesses are likely associated with a chemical exposure.”
- Many patients report use of cannabinoid/THC in e-cigarette.
- The CDC found a link: EVALI and vitamin E acetate - detected in all 29 bronchoalveolar lavage fluid samples.
- “Many different substances and product sources are still under investigation, and it may be that there is more than one cause of this outbreak.”


As of November 7, 2019: 20 cases have been reported among Allegheny County residents, with 14 confirmed, 4 probable, and 2 still under investigation. These cases range in age from 17 to 34 years, and most (85%) are male. All have been hospitalized, with 6 in and ICU. Almost all (90%) report vaping THC products within the past 90 days.

- Nationwide 2,172 cases (confirmed and probable) and 42 deaths have been reported to CDC as of Nov 14.
- Nationally, the majority of cases (86%) report vaping THC products.
Some E-cigarette Users Are Having Seizures

- Between 2010 and early 2019, the FDA determined that, between the poison control centers and the FDA, there were a total of 35 reported cases of seizures mentioning use of e-cigarettes
- Seizures are potential side effects of nicotine toxicity
  - Intentional or accidental swallowing of e-liquid
  - Recent uptick in voluntary reports of adverse experiences with tobacco products that mentioned seizures occurring with e-cigarette use (e.g., vaping) signal a potential emerging safety issue

Heart problems

- Two studies indicate that vaping is just as harmful, or possibly more harmful, for the heart than smoking.
- Higher levels of unhealthy LDL cholesterol, on average, compared with nonsmokers, and levels of healthy HDL cholesterol were lower among people who used both traditional and e-cigarettes
- Heart’s “ability to pump blood was diminished both during exercise and rest” in vapers rather than just during exercise as was the case in smokers
- “People are making the assumption if they switch from cigarettes to e-cigarettes, their risk will be substantially reduced of cardiovascular disease. That’s not necessarily the case.”
Safety Concerns

Burns
• 2,035 explosion and burn injuries seen in US Emergency Departments from 2015-2017

Poisonings
• 8,269 liquid nicotine exposures reported among children <6 from 2012-2017
• Child-resistant packaging laws associated with decreasing exposure rates (required in 2016)

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Tobacco Use Prevention as Anticipatory Guidance

- Start early to prevent initiation (even 5-10 year olds!)
- Messages for adolescents: effects on appearance, breath, sports performance, lack of benefit for weight loss, cost, how tobacco industry deceives them
- Tobacco dependence/addiction develops quickly
- Ask patients/parents to commit to be tobacco free and identify their own reasons for being tobacco free
Screen Parents and Teens

- Inquire about use and exposure during health supervision visits and visits for diseases that may be caused or exacerbated by tobacco

- Smoking includes cigarettes, electronic cigarettes, hookah, marijuana, etc.

Screening Teens with S2BI

Adolescent Form – Age 11 and older

1. Have you ever ridden in a car driven by someone (including yourself) who was "high" or had been using alcohol or drugs?  
   - No  
   - Yes

2. Do you ever use alcohol or drugs to RELAX, feel better about yourself, or fit in?  
   - No  
   - Yes

3. Do you ever use alcohol or drugs while you are by yourself, or ALONE?  
   - No  
   - Yes

4. Do you ever FORGET things you did while using alcohol or drugs?  
   - No  
   - Yes

5. Do your FAMILY or FRIENDS ever tell you that you should cut down or your drinking or drug use?  
   - No  
   - Yes

6. Have you ever gotten into TROUBLE while you were using alcohol or drugs?  
   - No  
   - Yes

In the past year, how many times have you used e-cigarettes, vape pens or JUUL?  
   - Never  
   - Once or twice  
   - Monthly  
   - Weekly or more

What substance do you use in e-cigarettes, vape pens or JUUL? (choose all that apply)  
   - Nicotine  
   - Marijuana or THC  
   - CBD

The following questions will ask about your use, if any, of alcohol, tobacco, and other drugs. Please answer every question by checking the box next to your choice.

IN THE PAST YEAR, HOW MANY TIMES HAVE YOU USED:

Tobacco?  
   - Never  
   - Once or twice  
   - Monthly  
   - Weekly or more

Alcohol?  
   - Never  
   - Once or twice  
   - Monthly  
   - Weekly or more

Marijuana?  
   - Never  
   - Once or twice  
   - Monthly  
   - Weekly or more

STOP if answers to all previous questions are “never.” Otherwise, continue with the questions.
Screening Teens with S2BI

- Do you use e-cigarettes, vape pens or JUUL?
  - No
  - Yes

- What substance do you use in e-cigarettes, vape pens or JUUL?
  - Nicotine
  - Marijuana or THC
  - CBD

- How often do you use this substance?
  - Once or twice
  - Monthly
  - Weekly or more

- Brief Advice
- Brief Intervention
- Brief Intervention & Consider Referral to Treatment

Nicotine Replacement Therapy for Vaping

- Not Evidence-based yet
- Presented at the 2019 AAP National Conference and Exhibition as general national clinician consensus
- Gum/lozenges as needed

<table>
<thead>
<tr>
<th>Amount they currently smoke per day</th>
<th>Starting Dose of Patch</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 + pods a day</td>
<td>21 mg</td>
</tr>
<tr>
<td>½ - 1 pod a day</td>
<td>14 mg</td>
</tr>
<tr>
<td>“A few hits a day”</td>
<td>7 mg</td>
</tr>
</tbody>
</table>
7. Prescribing a nicotine patch + gum together increases success of quitting by 350% vs. no medications.

True

Prescribing Nicotine Replacement Therapy

• Prescribing patch + gum together increases success of quitting by 350% vs. no medications
• Even if not willing to quit completely, use as harm reduction
8. Adolescents, under age 18, are allowed to purchase Nicotine Replacement Therapy over the counter.

**False**

“In the United States, tobacco dependence treatment medications have not been approved by the FDA for use by people younger than 18 years. There is, however, no biological or cognitive rationale to have 18 years as the cutoff for offering effective pharmacotherapy of tobacco dependence. To legally obtain any FDA-approved tobacco dependence treatment product (including the over-the-counter products), an adolescent needs a prescription from a licensed health care provider.”
Do Not Recommend E-cigs for Tobacco Dependence Treatment

- Not FDA-approved for tobacco dependence treatment
- Mixed evidence from Randomized Controlled Trials
- Among adolescents, e-cigarette use associated with decreased rates of smoking cessation

Clinical Practice Policy to Protect Children From Tobacco, Nicotine, and Tobacco Smoke. SECTION ON TOBACCO CONTROL. Pediatrics 2015;136;1008 DOI: 10.1542/peds.2015-3108

Case Study

John is a 16-year-old boy who is being seen at your office today. You administered the S2BI screen + vaping questions and John reported vaping nicotine weekly or more. You asked John if he would like to receive some information from you about vaping and he agreed. He reports using one JUUL 3% pod every day.
1. E-cigarettes contain multiple products including nicotine, carcinogens, metallic nanoparticles, flavorings, +/- psychoactive agents.

2. The number of adolescents vaping nicotine and THC increased significantly from 2018 to 2019.

3. E-cigarette use is associated with nicotine addiction, significant lung injuries, heart problems, and neurodevelopment impacts.

4. Nicotine replacement therapy for adolescents under the age of 18 years is considered off-label by the FDA but is supported by the AAP.

Questions?
Thank you for participating!