E-cigarettes and adolescents: responding to the new 'nicotine epidemic'

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1. The “vaping epidemic”
2. Vaping products
3. Nicotine and the teen brain
4. Health effects of e-cigarettes
5. Screening and brief intervention
6. Case simulations
7. Treatment for nicotine use disorder and e-cigarette use
The “vaping epidemic”
Growing concern over teens addicted to vaping as usage soars

JAN. 8, 2019 / 01:28

Vaping now an epidemic among US high schoolers

By Roni Selig, Davide Cannaviccio and Charlotte Hawks, CNN

Updated 6:47 PM ET, Fri April 6, 2018

Progress Erased: Youth Tobacco Use Increased During 2017–2018

• National Youth Tobacco Survey: nationally-representative sample of middle/high schoolers
• Conducted annually, school-based, self-administered, private/public schools

Source: https://www.cdc.gov/media/releases/2019/p0211-youth-tobacco-use-increased.html
Percentage of U.S. middle/high school students who report using tobacco products in past 30 days 2011–2018

In 2018...
- 27.1% any tobacco prod.
- 20.1% e-cigarettes
- ↑ 1,240% from 2011
- 7.2% of middle schoolers

YOUTH E-CIGARETTE USE IS RISING

E-CIGARETTES TYPICALLY DELIVER NICOTINE

E-CIGARETTE USE SURGED DURING 2017-2018

IN 2018:

1 IN 5 HIGH SCHOOL KIDS
1 IN 20 MIDDLE SCHOOL KIDS
CURRENTLY USE E-CIGARETTES

Source: https://www.cdc.gov/mmwr/volumes/67/wr/mm6745a5.htm?s_cid=mm6745a5_w#F1_down
Increasing frequent* e-cigarette use

High school e-cigarette users are using them more often.

*Among e-cig users, percent using >20 days in past 30 days

Use more than 20 days in the past 30 days
Vaping products
Vaping devices/e-cigarettes
Inside the e-cigarette...

- Propylene glycol
- Glycerin
- Nicotine

- Water Flavoring

- Potentially toxic contaminants and vaporization by-products

- Battery

- Heating element in the atomization chamber vaporizes the nicotine solution.

- Nicotine cartridge holds the nicotine solution. The nicotine content may be high, medium, low, or none.

- Mouthpiece

- Vapor
Dripping

- Thicker vapor
- Higher nicotine concentration (more addictive)
- Increased concentration and absorption of chemicals
- Burn risks with handling hot e-liquid
Advertising + Flavors = Youth e-cigarette use
E-cigarette use among youth is rising as e-cigarette advertising grows

Dollars spent on e-cigarette advertising

Past 30-day e-cigarette use among youth

Marketing e-cigarettes to youth

SOURCE: STANFORD SCHOOL OF MEDICINE, 2016,
http://tobacco.stanford.edu/tobacco_main/main_ecigs.php
E-juice flavors

The JUUL

Cool-Looking and Sweet, Juul Is a Vice Teens Can’t Resist
Sweet flavors...
JUUL nicotine content

• 1 JUUL pod = Has as much nicotine as 20 cigarettes!!
63 percent of teens, young adults, don’t believe JUUL e-cigarettes contain nicotine, survey shows

Source: Willett JG, Recognition, use and perceptions of JUUL among youth and young adults, BMJ Tobacco Control, Research letter, April 2018
99% of e-cigarette liquids sold in the US contain nicotine (Marynak, 2015)

Source: Monitoring the Future Survey, 2018
More than 1/4 of e-cigarette users say they also vape marijuana...

“Premium wax vaporizer”

“Liquid shatter” pen

Source: Monitoring the Future Survey, 2018
E-cigarette use a gateway drug?

- E-cig-only users new group of youth who may not have smoked otherwise (Dutra, 2017)
- E-cig use independently increases risk of subsequent cigarette smoking 3.5 times (systematic review by Soneji, et al., 2017)
- E-cigarette use strongly associated with use of alcohol, marijuana, and other drugs (Curran, 2018; Dai, 2018)
A Molecular Basis for Nicotine as a Gateway Drug

Eric R. Kandel, M.D., and Denise B. Kandel, Ph.D.
Nicotine: The Gateway Drug

Pre-exposure to nicotine made brain cells involved in addiction MORE RESPONSIVE TO COCAINE compared to no exposure to nicotine.

Nicotine and the teen brain
Brain maturation
Rational thinking gap

Functional Development

Reward and pleasure center

Rational brain

Age

Adolescent

Adult
Adolescents are developmentally primed to seek big rewards
Substance use and the teen brain

Activation of the reward pathway by addictive drugs

Pre-frontal cortex

Amygdala

Nucleus accumbens

Health effects of e-cigarettes
Surgeon general report: 2016

E-cigarette Use Among Youth and Youth Adults: A Report of the Surgeon General

E-cigarettes.SurgeonGeneral.gov
E-cigarettes: what are the risks?

• Short- and long-term changes to the brain
• Increased risk for addiction
  – Nicotine addiction
    • Use of two or more tobacco products
  – Use of alcohol and other drugs (such as cocaine, methamphetamine)
• Lung exposure to toxic chemicals and carcinogens
• Burns
Nicotine and the teen brain: short term effects

• Nicotine takes 10-15 seconds to reach the brain
  – Effects last approximately 30 minutes
• Adrenal glands release epinephrine, increases BP and HR
• Activates Ach receptors – increases dopamine, serotonin and glutamate, leading to pleasure center activation
  – Highly addictive: More than alcohol and cannabis; similar to cocaine
Nicotine works inside cells to reinforce addiction...

Source: Shivange AV, Borden PM, Muthusamy AK, et al. Journal of General Physiology, 2019
Nicotine works inside cells to reinforce addiction...

Source: Shivange AV, Borden PM, Muthusamy AK, et al. Journal of General Physiology, 2019
Nicotine works inside cells to reinforce addiction...

Source: Shivange AV, Borden PM, Muthusamy AK, et al. Journal of General Physiology, 2019
Nicotine effects vs withdrawal

Nicotine Effects
• Alertness (short term)
• Reduced appetite
• Palpitations
• Increased blood pressure and heart rate

Nicotine withdrawal symptoms
• Headaches
• Anxiety, irritability
• Difficulty concentrating
• Restlessness
• Hunger
• Tremor
• Sweating
• Dizziness

Teens usually have less severe withdrawal symptoms than adults, but they happen much earlier
What is in e-cigarette smoke?

- Volatile organic compounds
- Ultrashort particle size
- Nicotine
- Cancer-causing chemicals
- Heavy metals such as nickel, tin, and lead
- Flavoring such as diacetyl, a chemical linked to a serious lung disease
E-cigarette smoke: long-term risks

- E-cigarette vapor *may be* less hazardous than tobacco smoke
- *Pediatrics*, (Rubinstein, 2018): E-cigarette smoke contains toxic chemicals, heavy metals and carcinogenic compounds
  - Acrylonitrile
  - Acrolein
  - Propylene oxide
  - Acrylamide
  - Crotonaldehyde
E-cigarettes: acute harms


- Alarming increases in rates of e-cigarette burns, often severe: risk of explosion
- Most burns (72%) occur when device stored in front pocket
- Multiple accounts of disfiguring facial burns
- Manipulation of hot e-liquids during “dripping”
E-cigarettes: burn risks

16 year-old, 2nd degree burn
20 year-old, 2nd degree thigh burn
Screening and brief intervention
Screening

• Most pediatric providers report routine substance use screening; few physicians report using a validated screening tool

• Screening tools:
  • CRAFFT (1.0 or 2.0) - Arch Ped Adol Med (Knight, 2002)
  • Brief Screener for Tobacco, Alcohol, and other Drugs (BSTAD) - Pediatrics (Kelly S, 2014)
  • S2BI (Screening to Brief Intervention) - JAMA (Levy S, 2014)
Screening, Brief Intervention and Referral to Treatment (SBIRT)

Use validated screening tool to identify risk level and appropriate intervention

Abstinence
- Positive Reinforcement

Substance use without a disorder
- Brief Health Advice

Mild/moderate substance use disorder
- Brief Intervention

Referral to Treatment

Screening to Brief Intervention (S2BI)

S2BI
In the past year, how many times have you used:

- Tobacco, nicotine or e-cigarettes like JUUL?
- Alcohol?
- Marijuana?

<table>
<thead>
<tr>
<th>Weekly</th>
<th>Monthly</th>
<th>Once or twice</th>
<th>Never</th>
</tr>
</thead>
</table>

The 5 As

- **Ask** about use
- **Advise** to quit
- **Assess** readiness to quit
- **Assist** in quit attempt
- **Arrange** follow-up

Brief intervention

- Use a patient-centered strengths-based approach
- Advise adolescents to consider cessation
- Provide information about health consequences
- Use a non judgmental approach
- Determine readiness or willingness to quit (on a scale from 1 to 10...
Motivational interviewing: eliciting change

- Counselling method informed by level of readiness based on stages of change
- Assisting patients to resolve ambivalence
- Aims to elicit the patient’s own reasons for change and advantages favoring change
Core Interviewing Skills in MI

• **O**pen-ended questions
• **A**ffirmations
• **R**eflective listening
• **S**ummarizing
Some terms you might hear...

- **Vaping/e-cigarette products:**
  - Brands: JUUL, Vuse, MarkTen, blu e-cigs, and Logic (and many others)
  - E-liquids, e-juice
  - Dabs, dab pens, dab cards – (marijuana)

- **Techniques:**
  - JUULing, vaping – using an e-cigarette
  - Drip, dripping or juicing – using e-liquids directly on heating coil
  - Ghosting – hiding e-cigarette vapor in the mouth/airways

- **Health effects/problems:**
  - Getting “nicked” – Euphoria experienced with high doses of nicotine
  - Getting “nic sick” – Heart palpitations, nausea/vomiting, light-headedness with nicotine e-cigarette overuse
Case simulations
Jeremy

- 16 years old, high school, soccer player, oldest of three children
- Severe persistent asthma, last hospitalization 6 months ago
- Jeremy is referred to your practice after he was caught vaping in the bathroom at school
Jeremy

- Uses a JUUL he found at school, and has recently started smoking a “few cigarettes a week”
- Likes the social aspect of “JUULing”
- Uses high nicotine concentration pods/e-liquids
- Says he would quit smoking, but is not interested in quitting vaping “it helps with my anxiety”
- During your visit, he complains of a headache and asks permission to use his JUUL “I was with my mom and I couldn’t vape all day”
Jeremy

• What would you tell Jeremy about smoking/vaping?
• What other questions would you like to ask him?
• How could you help him quit smoking/vaping?
Case simulations

- Roll the dice 3 times
- The number on the dice will correspond to the variables for the clinical ‘case’ that your group will discuss re: approach to assessment and treatment
- What additional information might you want?
- What are the issues to consider in approaching the patient’s e-cigarette use?
- Discuss with your neighbor(s) and then we will share each scenario as a larger group
Roll the dice...

<table>
<thead>
<tr>
<th>Dice roll</th>
<th>Age</th>
<th>Exposure</th>
<th>Presentation/context</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12M</td>
<td>Uses a JUUL “socially”</td>
<td>Depression with suicidal ideation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use: A few times/wk with friends</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>13F</td>
<td>Owns a JUUL</td>
<td>School difficulties (falling grades)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use: ½ pod/day</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>14M</td>
<td>Owns multiple JUULs</td>
<td>Exacerbation of asthma</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use: 1-2 pod(s)/day</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>15F</td>
<td>Uses refillable e-cigarettes with nicotine and marijuana (daily use)</td>
<td>Sports participation physical</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>16M</td>
<td>E-cigarettes daily and traditional cigarettes occasionally</td>
<td>Parental and peer e-cigarette use</td>
</tr>
<tr>
<td>6</td>
<td>17F</td>
<td>E-cigarettes, cigarettes, hookah, marijuana and alcohol use</td>
<td>Anxiety with panic attacks</td>
</tr>
</tbody>
</table>

What additional information might you want to obtain?
What are the issues to consider in approaching the patient’s e-cigarette use?
A review of evidence-based strategies to treat nicotine use disorder
<table>
<thead>
<tr>
<th>Method</th>
<th>Nonpharmacologic Methods vs Minimal or Usual Care, Risk Ratio (95% CI)</th>
<th>No. of Trials in Meta-analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonpharmacologic methods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking cessation counseling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual</td>
<td>1.39 (1.24-1.57)</td>
<td>22</td>
</tr>
<tr>
<td>Group</td>
<td>1.98 (1.60-2.46)</td>
<td>13</td>
</tr>
<tr>
<td>Telephone quit line</td>
<td>1.37 (1.26-1.50)</td>
<td>9</td>
</tr>
<tr>
<td>Physician intervention</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brief advice to quit vs no advice or usual care</td>
<td>1.66 (1.42-1.94)</td>
<td>17</td>
</tr>
<tr>
<td>Brief counseling vs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No advice or usual care</td>
<td>1.84 (1.60-2.13)</td>
<td>11</td>
</tr>
<tr>
<td>Brief advice</td>
<td>1.37 (1.20-1.56)</td>
<td>9</td>
</tr>
</tbody>
</table>

| Pharmacologic Methods vs Placebo or No Treatment |
|--------------------------------------------------|-----------------------------------------------------------------------|------------------------------|
| Pharmacologic methods                           |                                                                        |                              |
| First-line drugs                                 |                                                                        |                              |
| Bupropion SR                                     | 1.69 (1.53-1.85)                                                      | 36                           |
| Varenicline                                      | 2.27 (2.02-2.55)                                                      | 14                           |
| Nicotine replacement                             |                                                                        |                              |
| Patch                                            | 1.66 (1.53-1.81)                                                      | 41                           |
| Gum                                              | 1.43 (1.33-1.53)                                                      | 53                           |
| Lozenge                                          | 2.00 (1.63-2.45)                                                      | 6                            |
| Inhaler                                          | 1.90 (1.36-2.67)                                                      | 4                            |
| Nasal spray                                      | 2.02 (1.49-3.73)                                                      | 4                            |
| Second-line drugs                                |                                                                        |                              |
| Nortriptyline                                    | 2.03 (1.48-2.78)                                                      | 6                            |
| Clonidine                                        | 1.63 (1.22-2.18)                                                      | 6                            |
• Screen all patients for tobacco exposure
• Advise patients to abstain from all forms of tobacco
• Do not recommend e-cigarettes for smoking cessation/reduction
• Offer pharmacotherapy to adolescent daily smokers
Nicotine Replacement Therapy (NRT)

• Can be used to help teens quit or cut down
  – Patches, lozenges and gums
  – Sprays and inhalers not recommended in teens

• Safe and minor side effects
  – Skin irritation, dry mouth
Efficacy of Pharmacotherapy for Smoking Cessation in Adolescent Smokers: A Meta-analysis of Randomized Controlled Trials.

Myung SK¹,²,³, Park JY⁴.

<table>
<thead>
<tr>
<th>Study</th>
<th>RR (95% CI)</th>
<th>Weight (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003 Hanson</td>
<td>1.11 (0.49, 2.50)</td>
<td>25.02</td>
</tr>
<tr>
<td>2004 Killen</td>
<td>1.05 (0.31, 3.52)</td>
<td>11.24</td>
</tr>
<tr>
<td>2004 Niederhofer</td>
<td>3.00 (0.77, 11.74)</td>
<td>8.83</td>
</tr>
<tr>
<td>2005 Moolchan</td>
<td>4.50 (0.59, 34.29)</td>
<td>3.99</td>
</tr>
<tr>
<td>2006 Roddy</td>
<td>2.50 (0.51, 12.28)</td>
<td>6.50</td>
</tr>
<tr>
<td>2007 Muramoto</td>
<td>2.38 (0.87, 6.51)</td>
<td>16.22</td>
</tr>
<tr>
<td>2008 Rubinstein</td>
<td>0.16 (0.01, 3.06)</td>
<td>1.86</td>
</tr>
<tr>
<td>2011 Gray</td>
<td>2.51 (0.52, 11.97)</td>
<td>6.73</td>
</tr>
<tr>
<td>2014 Scherhof</td>
<td>1.42 (0.57, 3.55)</td>
<td>19.63</td>
</tr>
<tr>
<td><strong>Overall</strong> (I² = 0.0%)</td>
<td><strong>1.62 (1.08, 2.44)</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>
Other Medications

• **Bupropion** (Wellbutrin)
  – Anti-depressant, some evidence of effectiveness in adults
  – Best if combined with counseling/NRT
  – Limited evidence in youth
  – Contra-indications: Seizures, eating disorders

• **Varenicline** (Chantix)
  – Highest quit rates in adults of all single interventions
  – Limited evidence in youth
  – Adverse effects: Possible increase suicidality, vivid dreams
Treatment Strategies for E-cigarette Use

• It is currently unknown how to best assist adolescents who want to quit vaping
Resources

E-cigarettes.surgeongeneral.gov

AAP Richmond Center: richmondcenter.org
Clinicians across the country report using the following techniques to treat adolescents who use e-cigarettes (currently not evidence-based)

- **Patch**
  - 1+ pod/day: 21 mg
  - ½-1 pod per day: 14 mg
  - A few “hits” a day: 7 mg

- **Lozenges and gums**
  - As needed

- **Switching to lower nicotine concentration products**

- **Biofeedback**

- **CBT and MI**
Back to Jeremy...

- Jeremy accepts to use a 14mg nicotine patch
- He is offered nicotine gums and lozenges (he chooses lozenges)
- He manages to quit smoking, but continues to vape “socially”
- Recently started vaping using high concentration “medicinal” THC oil, “it’s purer and after all, it’s legal in Massachusetts...”
Take home messages
Take home messages

- E-cigarette use is very common in adolescents and rates are increasing.
- E-cigarettes carry important risks for teens’ health.
- E-cigarettes should not be used as a smoking cessation tool in adolescents.
- Parents, schools and health providers can help teens quit, however more research is needed.
Questions?