Emerging Issue in Nicotine Dependence Treatment: The Rise of ENDS

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Objectives

• Introduce ENDS products and what elements of their design may be cause for concern.
• Investigate whether ENDS are useful as cessation devices.
• Differentiate 1\textsuperscript{st}-3\textsuperscript{rd} generation ENDS and the pod-based products (e.g., JUUL) and propose potential clinically relevant information.
The Rise of ENDS
The Ages of Tobacco

- Pre-Columbian
- Global Trade
- Cigarette Rolling Machine
- "Cigarette Century"
- First e-cigarette Patent
- Juul
- Age of the Alternatives
Introduction to ENDS
Electronic Nicotine Delivery Systems (ENDS)

A battery-powered device that provides inhaled doses of nicotine
<table>
<thead>
<tr>
<th>Types of ENDS</th>
<th>Distinguishing Factors</th>
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</table>
| Electronic cigarettes (e-cigarettes) Cigalikes | • Physically similar to cigarettes  
• Come in disposable or refillable/rechargeable forms  
• Some emit a light when the user puffs  
• Relatively short battery life  
• Relatively less efficient nicotine delivery |
| Vaporizer (or vape) pen             | • Come in various sizes, does not resemble a cigarette  
• Comes in disposable or rechargeable forms  
• Slim like a pen  
• Can be modified |
| Modifiable systems Advanced personal vaporizers (MODs) | • Larger device  
• Most are rechargeable  
• Can be modified  
• Larger batteries  
• Relatively more efficient nicotine delivery |
| Electronic water pipe/hookah        | • Electronic versions of traditional water pipe/hookah  
• Relatively less efficient nicotine delivery |
| Pod-based products (e.g., JUUL)      | • Look like a piece of tech  
• The “iPhone of e-cigarettes” |
All Adult ENDS Users (18-65)

- Currently Dual Using: 59%
- Former Smoker: 30%
- Never Smoker: 11%

Young Adult ENDS Users (18-24)

- Currently Dual Using: 43%
- Never Smokers: 42%
- Former Smokers: 15%
Facts about Youth Vaping

• Teen vapers had higher risk of adolescent adjustment problems, delinquent behavior, and substance abuse than non-users\(^1\)
• High externalizing or internalizing problems (GAIN-SS) were at higher risk of using eicgarettes.\(^2\)
• Use of flavors is high among reasons to vape and is highly correlated with persistent use
• Weight loss/management is a high-saliency issue
• Teens often do not know that pods contain nicotine or that the nicotine in pods is “not addictive” or occurs in low amounts
• Sources of information for teens are: ads, friends/family, social media/internet
Particulates in ENDS Aerosol

The types of particles in ENDS aerosol is influenced by a number of factors, including:

- Device engineering
- Nicotine content
- Other additives
- Puffing time
Propylene Glycol and Glycerol

- Propylene glycol and glycerol are “generally recognized as safe” by the FDA
  - Unknown whether heating and inhaling directly affects safety
- Can cause eye and respiratory irritation
Nicotine

• **Health Effects**
  • Potential role in cancer development
  • Cardiovascular effects
  • Promotes development of diabetes
  • Developmental effects (ages 0 - 25)
  • Acute toxicity ($\text{LD}_{50}$ 6.5-13mg/kg)

• **Addiction**

• **Quality of Life and Social Justice**
Other Compounds in ENDS Aerosol

- Metals such as tin, silver, iron, nickel, cadmium, copper, aluminum, and chromium
- Fine and ultrafine particles
- Flavoring compounds
  — Flavorings appear to be related to cytotoxicity
Secondhand Emissions

Emissions from exhalation of vapor include:

- Nicotine
- Particulates
- Potentially toxic organic chemicals
- Heavy metals
"While ENDS may have the potential to benefit established adult smokers...[they] should not be used by youth and adult non-tobacco users because of the harmful effects of nicotine and other risk exposures."

*Tim McAfee, former director of the Office on Smoking and Health Centers for Disease Control and Prevention*
ENDS as Cessation Devices
Can ENDS help people quit?

Even if they do, are they creating life-long ENDS users?
Research Findings

Studies have found mixed results for ENDS and tobacco cessation:

- 85% of users report using ENDS for cessation; 11% reported quitting
- One study found e-cigarette users had a higher quit rate (20%) than those using NRT (10%)
- QuitLine using e-cigarettes were less likely to quit smoking than nonusers (16-21% vs. 31%)
- Still, many studies find no difference in quit rates between e-cigarettes and NRT
Are there benefits to decreasing cigarette use?

- To achieve a 42% reduction in exposure to carcinogens, users need to reduce the number of cigarettes smoked by about 90%.
- Only 1-15% of e-cigarette users who continued to smoke were able to reduce cigarette use by 90%.
Podbased Products: Differences and Clinical Relevance
The cigarette is among the most awe-inspiring examples of the ingenuity of man. The cigarette should be conceived not as a product but as a package. The product is nicotine. Smoke is beyond question the most optimized vehicle of nicotine and the cigarette the most optimized dispenser of smoke.

William L. Dunn, Jr., Philip Morris (1972)
Qualities of Cigarettes Related Nicotine Addiction

- Dose controlled via “puff topography” modifications
- Absorption of nicotine through lungs is rapid
- Rapid metabolization requires regular, small doses
- Regular, small doses develops the *habit*
  - Frequent experience of euphoric effects
  - Frequent experience of withdrawal discomfort
What is JUUL?

Familiar Ideas

• A battery-powered device that provides inhaled doses of nicotine (ENDS)
• Battery is rechargeable (like 2\textsuperscript{nd} and 3\textsuperscript{rd} generation products)
• Not (designed to be) modifiable, except aesthetically
• Most popular products are flavors like Mango and Cool Mint

Innovations

• Marketed primarily via Twitter and Instagram
• Marketed heavily (by Juul Labs) as a permanent replacement for cigarettes
• Design: “the iPhone of e-cigarettes”
• Charges by plugging it into a computer USB port
• Initially had only one concentration of nicotine (40mg/pod)
• Nicotine salt formulation
Plasma Nicotine Concentrations

Plasma nicotine (mcg/L)

- Cigarette
- Moist snuff
- Nasal spray
- Inhaler
- Lozenge (2mg)
- Gum (2mg)
- Patch

Time since exposure (min)
Plasma Nicotine Concentrations

FIG. 4
Alterations to Clinical Best Practice
# Treatment Planning Basics

<table>
<thead>
<tr>
<th>Conventional Products</th>
<th>Juul &amp; other ENDS</th>
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<tbody>
<tr>
<td><strong>ASK</strong></td>
<td>Screen for tobacco smoke exposure (including second- and thirdhand smoke)</td>
</tr>
<tr>
<td><strong>ADVISE</strong></td>
<td>In a firm, not judgmental manner, relevant manner inform the user that the best thing they can do for their health now and in the future is to quit tobacco.</td>
</tr>
<tr>
<td><strong>ASSESS</strong></td>
<td>Assess the clients willingness to engage in cessation activities (e.g., Stages of Change) and also, using a validated instrument, assess the user’s dependency level.</td>
</tr>
<tr>
<td><strong>ASSIST</strong></td>
<td>Educate the clients on the harms of use and the benefits of quitting, identify triggers, and identify barriers and (to the greatest extent possible, assist the user in finding solutions for their identified barriers.</td>
</tr>
<tr>
<td><strong>ARRANGE</strong></td>
<td>Schedule a follow-up call or visit with the anticipation of addressing newfound barriers and triggers, troubleshooting pharmacotherapy usage, and general progress toward cessation.</td>
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Tips to address ENDS use

- **Listen** and **acknowledge** user’s experience
- **Educate** and address misconceptions
- **Assist** user’s in accurately assessing risks
- **Refer** to quitline or other resources
Weighing the Benefits and Risks

<table>
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<th>Benefits</th>
<th>Risks</th>
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<tr>
<td>Harm reduction to user*</td>
<td>Unknown health risks long term; benefits may only be seen if reduce-to-quit</td>
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<tr>
<td>Reduced secondhand exposure</td>
<td>Secondhand vapor contains nicotine and other chemicals but at lower amounts than cigarettes; short and long-term exposure risk is unknown</td>
</tr>
<tr>
<td>Possibility for cessation</td>
<td>Prolonging nicotine addiction; creating addiction in youth</td>
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<td></td>
<td>Renormalizing smoking behaviors</td>
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*Only if cigarette use is stopped completely or dramatically reduced
Messages to Communicate

- Emissions are an aerosol containing solid particulate matter including heavy metals, not harmless water vapor
- Products may produce harmful carcinogens like formaldehyde or other harmful chemicals like diacetyl
- Ejuice has been known to be mislabeled (e.g., some “0mg” ejuices actually contain nicotine)
- The nicotine in ENDs and the nicotine in cigarettes are equally addictive and equally harmful to developing bodies
Clinical Recommendations

- Educate on the harms of use and benefits of quitting—correcting misinformation when it noticed
- Explore use patterns (regularity of use, cravings, social use)
- Design a quit plan including quit date, planning around triggers
  - Changing Behaviors
  - Social support
  - Encouraged technology (This is Quitting, other apps)
- Pharmacotherapy
  - Adults: Increases quit success 20%
  - Youth: Last line defense
Behavioral Health & Wellness Program

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