The VAPE Explosion – Update October 2019 (School Version)

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What is “vaping”? 
What is Vaping?

“Vaping” refers to use of an electronic "vaporizer". It is an aerosol produced by heating a liquid.

How do they work?

- Devices contain a battery, a reservoir, a heating element or atomizer, and a mouthpiece
- Inhalation activates the device to heat the liquid in the cartridge and convert the liquid into an aerosol
Classifications

- Diverse products are available: “E-cigs” “vapes” “vape pens” “e-hookahs” “mods”
- Look like regular cigarettes, cigars, or pipes. Some look like pens, USB sticks, and other everyday items
Popular devices

Sourin Air Kit:

- Smaller than a credit card
- Refillable
Juul – Most popular among teens

The Juul, resembles a flash drive and is the most popular e-cigarette used by teens. (72% of the e-cig market in U.S.)

- Can be charged in a USB port
- It is not refillable
- It *always* contains nicotine
- Approximately 200 puffs equal to a pack of cigarettes
- Nicknamed “Juuling”
- Starter pack @ $50.00/4 pods
- Some teens mention going through a POD in a few hours
Concerning models / Stealth or Incognito vaping

Look like Metered Dose inhalers (MDIs) or Dry Powder inhalers

This newer unit is actually only 80% as large as the Puffit 1 and this helps to make it look even more like an authentic asthma inhaler. ... Yes, this does indicate that the Puffit 2 is a conductive vaporizer. ... Most Helpful Puffit 2 Vaporizer by Discreet Vape Reviews.
Stealth or Incognito vaping
Dripping

“Dripping,” is a technique often used by youth

- E-liquids is dripped directly onto the heating coils, instead of inhaling from the mouthpiece

- Teens stated the “dripping” method produces thicker clouds of vapor, a stronger hit in the back of the throat when inhaled, and a more pleasurable taste
What is in the e-liquid?
What is in the e-Liquid?

Can contain harmful substances (nicotine is in 99% of the non-THC liquids)
Juul - Nicotine Salts which allows the nicotine to cross the blood-brain easier compared to free-base nicotine (nicotine is often referred to being as addictive as opioids or heroin)

Potentially harmful substances
Most are present in cigarette smoke at higher levels
- Heavy metals (Lead, Nickel, Chromium, Zinc)
- Formaldehyde
- Polyethylene Glycol (PEG) ***
- Propylene Glycol (PG), glycerin
- Vegetable Glycerin (VG)
- Medium Chain Triglycerides (MCT) ***
- Acrolein (byproduct of solvents)
- Vitamin E acetate ***
- Recent study conducted at Yale University found Acetals some flavors – may be especially irritating to the lungs.
Flavors? There are over 15,000!

Marketing has been heavily aimed at youth, by focusing on Instagram

$26 million dollars per day spent on marketing
Solvents

E-liquid contains solvents propylene glycol and glycerin. These solvents are safe for food and cosmetics.

- Minimal information available on safety if inhaled

**Propylene glycol** - used in antifreeze and de-icing solutions.

- Absorbs extra water and maintains moisture in medicines, cosmetics, or food products
- It is a solvent for food colors and flavors
- Also used in the cigarettes to keep the tobacco from drying out

**Glycerin** is found in the natural fats of vegetables and animals

- Commonly used as a moisturizer
Flavorings appear to affect cell toxicity, especially strawberry, cinnamon, bubble gum and cotton candy flavors.

- Product type, battery voltage and flavors significantly affected toxicity
- Strawberry-flavored product being the most cytotoxic
- Cinnamon flavor in e-liquid contain cinnamaldehyde (highly toxic to human cells) and decreased movement of cilia
- Cotton Candy and Bubble Gum contain aldehydes – can cause airway constriction

FDA
Content accuracy? – What is actually in the e-cig.

Studies have shown that there is high variability in e-cigarette contents.

• The basic technology behind e-cigarettes is consistent, but there is an enormous variability within the product
• The products have different ingredients, different hardware and deliver highly variable amounts of nicotine
Nicotine concentrations

10 brands analyzed

Comparison of the Performance of Cartomizer Style Electronic Cigarettes from Major Tobacco and Independent Manufacturers

• One brand had nicotine concentration within 10% of the labeled value
• Most brands had less nicotine than the labeled
• One brand (*Smoke 51*) had 60% more nicotine than labeled
• 5 of the brands had considerable variation purchased at different times
Who Vapes?
Many adults use e-cigarettes.

- Conflicting research about the effectiveness with cessation

Our primary concern is with teen users

- Tobacco use among youth has been declining, but e-cig use has been on the rise

- 2018 – 4.9 million middle and high school students used within 30 days, up from 3.6 the prior year (CDC – 2018)

Youth e-cigarette users often begin using e-cigarettes because of the flavors.

43% of youth who had ever used e-cigarettes tried them because of appealing flavors

- Most did not know that e-cigarettes contain nicotine
Healthy Kids Colorado Survey

The Healthy Kids Colorado Survey is aligned with the Centers for Disease Control and Prevention’s (CDC’s) Youth Risk Behavior Survey (YRBS).

It has been conducted on a two-year cycle since 1991.

- Professional researchers use a random sample of Colorado students to represent students in grades 6-12.
- In 2017, the survey sampled 56,000 youth from 190 middle and high schools.
- Youth that can ask a parent for help are 31% less likely to vape.
- Youth in extracurricular activities are 12% less likely to vape.

Healthy Kids Colorado Survey and Smart Source Information
https://www.colorado.gov/pacific/cdphe/hkcs
Results
Colorado has a higher prevalence of current e-cigarette users compared to national results.

- National 13.2%; Colorado 27% (more than double)
- Males are more likely than females to use e-Cigarettes in the past 30 days
- Older grades (10 – 12) have a higher prevalence
- Why higher? Not sure, but Colorado and North Carolina are tobacco product test states

![Current E-Cigarette Use (Past 30 Days)]

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>National</td>
<td>13.2%</td>
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<tr>
<td>Colorado</td>
<td>27.0%</td>
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<tr>
<td>9th grade</td>
<td>18.5%</td>
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<tr>
<td>10th grade</td>
<td>25.3%</td>
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<tr>
<td>11th grade</td>
<td>31.7%</td>
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<tr>
<td>12th grade</td>
<td>33.6%</td>
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</table>
Safe to Vape?

Is vaping safe?
Life Span

Average lifespan is about 75 years

| Youth first 25 years | Adulthood 50 years |

Individuals spend twice as much time in adulthood, so what is done in youth and young-adulthood may significantly impact a large portion of your life.
In the News: Over 500 Hospitalizations May Be Linked to Vaping

Oct. 25, 2019 -- Possible vaping-related severe breathing problems have led to over 1604 (confirmed and probable cases) of teens and young adults (primarily 18-25 yrs.) in over 49 states and the numbers continue to increase. 34 deaths have occurred in 21 states. (CDC update 10/25/2019)

80% of cases are under the age of 35 years (16% under 18, 21% 18-20 years)

Being referred to as (e-cigarette/vaping associated lung injury or EVALI). a Full-blown acute respiratory distress syndrome/potential chemical exposure

No clear causation: CDC is investigating (black-market vs. regular branded, THC vs. nicotine, Vitamin E vs. no Vitamin E…)

Seeing permanent lung damage in many of the cases
CDC findings

As of 9/29/2019

- 77% used THC products
- 57% used Nicotine products
- 36% stated they used THC only
- 16% stated they used Nicotine only
- 86 Patient interviewed in Illinois, 66% stated they used a product called DANK, counterfeit brands used by distributors to market THC cartridges. They individuals reported using 234 different products
DANK Products
# Symptoms of the Vaping Illness

## Common symptoms seen in patients with vaping illness

*Based on 53 patients treated in Wisconsin and Illinois.*

### Respiratory symptoms
- Shortness of breath
- Chest pain
- Chest pain when breathing
- Cough
- Coughing up blood

### Gastrointestinal symptoms
- Nausea
- Vomiting
- Diarrhea
- Abdominal pain

### Other symptoms
- Fever
- Chills
- Weight loss
- Fatigue or malaise
- Headache

*Source: New England Journal of Medicine  
Graphic: Jiaochuan Wu / NBC News*
Patient Hx: 95% respiratory symptoms (cough, chest pain, SOB) 
77% GI symptoms (Abdominal pain, nausea, vomiting, diarrhea) 
Constitutional symptoms: fever, chills, weight loss

Recommended ?: Ask about smoking, e-cigarette, vaping, or other related devices (nicotine, THC, cannabis oils/dabs)

Physical Exam: 55% reported tachycardia, 45% tachypnea, 57% had low Sp02 <95% on RA

Laboratory Testing: Strongly consider a respiratory virus panel, including influenza (during flu season). Follow guidelines for community-acquired pneumonia. Elevated WBC counts, serum inflammatory markers (C-reactive protein, erythrocyte sedimentation rate (ESR), and liver transaminases. With informed consent a drug screen for THC

Imaging: CXR and if warranted a CT
Severe Vaping Related Illness - VAPI

Severe Respiratory Distress known as Vaping-Associated Pulmonary Injury

Common diagnosis:
Lipoid Pneumonia – Fatty/oil type particles enter the lungs along with severe inflammation
Teens in ICU from VAPI

I WANT TO START A NO VAPING CAMPAIGN
Teens in ICU from Vaping
Will This be the New Face of Chronic Lung Disease

Vs.

Lung tissue samples from 17 patients (13 male, 4 female age range 19-67)
2 of the patients were deceased

Biopsy findings done at The Mayo Clinic in Scottsdale, Az.

All 17 had a pattern of injury from toxic chemical exposure/chemical burn
Dr. Brandon T. Larson Surgical Pathologist
In the News: FDA are investigating 127 cases of seizures or other neurological issues after people used e-cigarettes

**FDA In Brief: FDA encourages continued submission of reports related to seizures following e-cigarette use as part of agency’s ongoing scientific investigation of potential safety issue**

“The FDA is continuing its scientific investigation to determine if there’s a direct relationship between the use of e-cigarettes and a risk of seizure or other neurological symptoms. Although we still don’t have enough information to determine if e-cigarettes are causing these reported incidents, we believe it’s critical to keep the public updated on the information we’ve received based on the agency’s initial request for reports earlier this year. We appreciate the public response to our initial call for reports, and we strongly encourage the public to submit new or follow-up reports with as much detail as possible. Additional reports or more detailed information about these incidents are vital to help inform our analysis and may help us identify common risk factors and determine whether any specific e-cigarette product attributes, such as nicotine content or formulation, may be more likely to contribute to seizures,” said Acting FDA Commissioner Ned Sharpless, M.D.
Available Research

At this time there are few randomized controlled trials available

- Observational studies
- Most lab studies

There are many active trials on e-cigarettes in progress.
Nicotine

E-cigarettes are nicotine delivery devices (drug delivery device)

• Nicotine increases the risk of heart disease including stroke, vascular disease, heart attack, and aneurysm

• Highly addictive

Lucas McClain
Nicotine Addiction and the developing brain

Research on nicotine and youth shows:

• Dr. Christy Sadreameli, (*Ped. Pulmonologist at Johns Hopkins*) states that “e-cigarettes are harmful to teenager’s growing bodies- no matter the source”

• The adolescent brain is more sensitive to nicotine

• Adolescence smoking increases the risk of psychiatric disorders and cognitive impairment later in life

• Nicotine affects attention, memory, learning, and brain plasticity

• Withdrawal symptoms occur in youth prior to daily smoking or with low levels (1-2 per day)

• Anxiety is frequently described by teens when not able to vape

• Increases risk of other addiction
Withdrawal symptoms

Withdrawal symptoms from nicotine dependence include:

- Irritability
- Anxiety
- Difficulty concentrating
- Insomnia (difficulty sleeping)
- Restlessness
- Increased appetite

Usually peak within a few days and lasts for several weeks or even months

CDC
Popcorn lung?

In 2002, a chemical Diacetyl was linked to a lung disease, Bronchiolitis Obliterans. (8 workers at a popcorn factory).

In 2015, diacetyl was found in e-cigarettes and researchers suggested more research was needed.

• They did not report that Diacetyl is also in tobacco cigarette smoke, creating the impression that e-cigarettes are exposing users to a new chemical hazard
• Mass media publications then drove headlines stating “E-cigarettes cause popcorn lung”

There is no clear link between Diacetyl and bronchiolitis obliterans. Diacetyl is no longer used in e-cigarette liquid.
Toxic Metals

Metal Concentrations in e-Cigarette Liquid and Aerosol Samples: The Contribution of Metallic Coils
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Conclusions
Our results add to the existing evidence that e-cigarettes are a relevant source of exposure to a wide variety of toxic metals including Cr, Ni, and Pb as well as to essential metals that are potentially toxic through inhalation such as Mn and Zn. Metal concentrations in the e-liquid from the original dispenser increased markedly in the same e-liquid after it was added to the device and was brought into contact with the heating coil, both in the generated aerosol and in the liquid that remained in the tank. These findings support the hypothesis that metals are transferred from the device (most likely the coil) to the e-liquid and from the e-liquid to the aerosol that is inhaled by the user. Due to potential toxicity resulting from chronic exposure to metals in e-cigarette aerosols, additional research is needed to more precisely quantify metal exposures resulting from e-cigarette use and their implications for human health, and to support regulatory standards to protect public health.
Known Risk

(warning some of the following slides contain graphic photos)
Unintended Injury

- e-Cigarette batteries have caused fires and explosions and some have resulted in serious injuries.
- Most explosions happened when the e-cigarette batteries were being charged.
- Children and adults have been poisoned by swallowing, breathing, or absorbing e-cigarette liquid through their skin or eyes.
Battery explosion

Photo of an upper leg injury caused by an exploding battery. The e-cig device was in the guys pocket.
Battery Explosions – Facial Injuries
Facial fractures from Vaping device explosion
Nicotine Ingestion

As the numbers of individuals using e-cig/vaping has increased, so have the risks of accidental ingestion of the liquids (accounting for 42% of nicotine exposure related call to U.S. Poison Control Center in 2015)

Acts on both parasympathetic and sympathetic nervous systems
- binding with acetylcholine receptors

Symptoms after ingestion: (dose related)
- Low doses stimulate the neural and cardiovascular systems
- High doses suppress the vital systems
- Mild to moderate toxic doses may cause burning sensation in the mouth and throat, nausea, vomiting, abdominal pain, headache, confusion, dizziness, weakness, miosis, urination and defecation
- Higher toxic doses may lead to arrhythmias, bradycardia, convulsions, coma, dilated pupils, respiratory failure, rapid progression to hypotension, and death

Deok et al., Korean J Pediatrics 2016; 59(12): 490-493
Accidental Ingestions

Brief Case Study:
15 month old ingested 5 mL of liquid nicotine concentration – mistaken for cold medicine

- The child involuntarily vomited immediately following the ingestion, became unconscious and was unresponsive.
- Within minutes became pulseless, CPR started x 40 mins.
- Outcome: After 44 days declared brain dead and expired

Key points:
- Lethal dose of nicotine has been estimated to be less than 40 mg in adults & 1 mg/kg in children (LD50 1 mg/kg)
- Most common age group of exposure is under 5 years of age
- Children that have ingested even small amounts of liquid nicotine and are symptomatic should be referred for medical assessment/treatment
- An estimated 4745 cases of poisoning injuries presented to US EDs (2013-2017)
- In 2016, the Child Nicotine Poisoning Prevention Act became in effect requiring child-resistant packaging. Deok et al., Korean J Pediatrics 2016; 59(12): 490-493/ Chang et al. Injury Epidemiology (2019); 6:10
Accidental Ingestions

Outcome: After 44 days declared brain dead and expired

Key points:

• Lethal dose of nicotine has been estimated to be less than 40 mg in adults & 1 mg/kg in children (LD50 1 mg/kg)
• Most common age group of exposure is under 5 years of age, next common 20-39 years
• Children that have ingested 0.2 mg/kg or more of liquid nicotine and are symptomatic should be referred for medical assessment/treatment
• An estimated 4745 cases of poisoning injuries presented to US EDs (2013-2017)
• In 2016, the Child Nicotine Poisoning Prevention Act became in effect requiring child-resistant packaging.

(Chang et al. Injury Epidemiology (2019); 6:10)
How are e-Cigs Regulated?
FDA attempt to ban the flavors was nixed

In 2015, The FDA attempted to ban the flavored e-liquids

Over the course of 46 days, more than 100 tobacco lobbyist and small business owners met with White House officials

The result: Senior Obama administrative officials nixed the ban and much of the evidence

Following the ruling – Juul sales skyrocketed six-fold
New regulation

- The FDA recently finalized a rule that extends its regulatory authority to all tobacco products, including e-cigarettes, cigars, and hookah and pipe tobacco.
- Products not on the market as of February 15, 2007, will have to show that products meet the applicable public health standards set by the law.
- Required health warnings.
- Prohibited free samples.
- Restricted youth access – cannot be sold to those under 18 years.
- Banned vending machine purchases.
- 2016 - *Child Nicotine Poisoning Prevention Act*.
Patient/Family Education

As healthcare professionals we have a responsibility to educate individuals of the potential risks associated with vaping.

Educating parents about potential risks and what to look for (vaping devices, behavioral changes in their child...)

Educate patients about the potential risks and that it may take many years before we know the long-term impacts from vaping.

School district training- Meeting with parents, teachers and students

Respiratory Therapy Students going out to high schools and educating
State-Level Activity

Washington, Michigan, New York and Rhode island has temporarily banned flavored e-cigarette products

Gov. Charlie Baker in Massachusetts has banned all vaping products for four months

Denver just raised the age to 21! Retail licensure added 9/30/19

21 Communities require tobacco retail licensure

14 Communities raised legal age to 21 for tobacco products

4 Communities banned flavored liquids and e-cigarette

*Sadly, Colorado is only one of 12 states that do not require retail licensure
E-Cigarettes as a smoking cessation aid

- New England Journal of Medicine found that e-cigarettes were nearly twice as effective as conventional replacement therapy (18% vs. 9.9%)
- Lack of clear evidence from randomized studies about safety
- 80% of study participants were still using e-cigarettes at one year, compared to only 9% that used conventional replacement therapy
- Concerns about long-term nicotine addiction and e-cigarette exposure
- E-cigarettes have higher concentrations of nicotine compared to conventional
Latest product on the Market…

The FDA has approved for sale in the U.S. another nicotine delivery device

The FDA states that evidence does not support claims that Iqos cuts the health risks

Altria is releasing a device called “Iqos”
Futuristic-looking device that is similar to an e-cigarette, but it does not work the same

Heats tobacco sticks “Heatsticks” at a much lower temperature

Advertising states: Fewer and lower levels of some toxics than combustible cigarettes

Iqos uses actual tobacco and doesn’t have wild flavors

Costs about $70
Summary

• No one can predict with confidence what short- or long-term health risks may be linked to the e-cigarettes, Vaping devices or juice (liquid for the devices)
• E-cigarettes are not safe for youth, young adults, pregnant women, or adults who do not currently use tobacco products
• If you’ve never smoked or used other tobacco products or e-cigarettes, don’t start
• As healthcare professionals we all need to step up and educate patients, families, adolescents and parents on the risks of e-cigs/vaping
First, educate yourself.

Helpful resources:

1. Centers for Disease Control and Prevention.  
   https://www.cdc.gov

2. U.S. Surgeon General:
   • https://e-cigarettes.surgeongeneral.gov/
   • Parent Tip sheet for talking with your teen.

3. FDA's webpage.
   • Vaporizers, E-Cigarettes, and other Electronic Nicotine Delivery Systems (ENDS)
Thank you

QUESTIONS?