Vaping, Juicing and E-Cigarettes
Myths, Truths, Evidence
What Clinicians Should Know

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Disclosure

I have nothing to disclose

I have no conflict of interest
Objectives

- Identify E-cigarette devices, uses and exposures
- Describe effects of E-cigarettes on health including Cardiovascular diseases, Respiratory diseases and Cancers
- Identify the Public health effects of E-cigarettes, specifically: dependence and abuse liability, smoking initiation among youth, smoking cessation and Harm reduction
- Propose research needs addressing knowledge gaps
E cigarettes -Introduction

- E-cigarettes have been sold in the U.S. since at least 2007
- E-cigarettes and similar vaping devices have grown into a $4 billion-dollar U.S. industry
- E-cigarettes are now the most commonly used tobacco product among youth
- The FDA gained authority to regulate the devices in 2016 after years of pushback from the industry
E-Cigarettes-Introduction

• Despite their popularity, little is known about their health effects

• Perceptions of potential risks and benefits vary widely among the public, users of e-cigarettes, health care providers, and the public health community
E-Cigarettes- Public Perception
Perceived Harm of E-cigarettes, compared to Tobacco cigarettes and Marijuana

E-Cigarettes - Introduction
Who is using E-cigarettes

In 2016, more than 2 MILLION U.S. middle and high school students used e-cigarettes in the past 30 days, including:

- 4.3% MIDDLE SCHOOL STUDENTS
- 11.3% HIGH SCHOOL STUDENTS

Percentage of young adults who currently use e-cigarettes and conventional cigarettes; National Adult Tobacco Survey (NATS) 2013–2014

- 7.47%
- 9.58%
- 6.10%
- 4.16%
- 13.00%

[Bar chart showing the distribution of e-cigarette use among different age groups.]
Trends in ever e-cigarette use among U.S. middle and high school students; National Youth Tobacco Survey (NYTS) 2011–2015

Trends in past-30-day e-cigarette use among U.S. middle and high school students; National Youth Tobacco Survey (NYTS) 2011–2015

A Report of the Surgeon General
2016
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Some Definitions

- Vaping - word used to describe the use of an electronic nicotine delivery system
- It is called vaping because of the aerosol cloud given off during use
Vaping/Electronic Nicotine Delivery Systems

E-Cigarettes range in design, appearance, and complexity

Components:

- Battery
- Heating coil
- Atomizer that transforms the e-liquid to an aerosol
- Cartridge that contains the e-liquid
- Mouthpiece
Vaping/Electronic Nicotine Delivery Systems

The Juul vaporizer aka "JUUL" looks like a USB flash drive.
E - Cigarettes - Toxicology

E Cigarettes Contain Toxic substances

- True
- False
- Insufficient data
E – Cigarette contents

• The main ingredients of e-liquids include nicotine, vegetable glycerin, propylene glycol, water, and flavorings

• This complex concoction becomes even more complicated when flavorings are added

• When heated, some of these produce toxic substances

  Propylene glycol produces acrolein, formaldehyde, and benzene but when heated can convert to benzoic acid and benzene known to be carcinogenic
E- Cigarette contents

Nicotine

• The nicotine content of e-cigarettes varies widely among products, with varying degrees of agreement between nicotine content on the label and what is chemically measured.

• Regulatory standards are still lax.

  Of 32 samples, 9 (28 percent) had measured nicotine levels that deviated from the labeled nicotine strength by more than 20%.

• Nicotine yield increases with e-cigarette power and e-liquid nicotine concentration, and with increasing puff duration.

E –Cigarettes- contents

Substances identified in e-cigarette liquids and aerosols include:

• Nicotine (a variable percentage)
• Solvent carriers - Propylene glycol (PG) and glycerol (PG and glycerol)
• Tobacco-specific nitrosamines (TSNAs)
• Aldehydes, Metals, volatile organic compounds (VOCs), phenolic compounds, polycyclic aromatic hydrocarbons (PAHs), flavorings, tobacco alkaloids, and drugs
E – Cigarettes- Contents

• Other than nicotine, the number, quantity, and characteristics of potentially toxic substances emitted from e-cigarettes are highly variable and depend on
  
  Product characteristics
  
e-liquid characteristics
  
how the device is operated( Battery power)
Effects of nicotine solvent and battery output voltage on levels of carbonyl compounds released from Ecs, (puff duration 1.8 s, puff volume 70 ml, puff intervals 17 s)

E cigarettes – Toxicity
Benzaldehyde

Distribution of metal concentrations within and across brands E-cigarette like devices

E Cigarettes Toxicity

E-cigarette users may be exposed to pharmacological components in their devices’ e-liquids

In an analysis of e-liquids (Hadwiger et al., 2010) found evidence of a weight loss medication (rimonabant) originally approved in Europe. This treatment has been associated with adverse neurological events such as seizures and suicide, and is not approved by FDA (2007). Same study found e-liquid can contain an analogue (amino tadalafil) to the active ingredient in Cialis.

The potential exposure to medicinal compounds in some e-liquids places users at risk of experiencing undetermined or harmful health effects.
E Cigarettes Contain Toxic substances

- True

Contemporary data suggests that in addition to nicotine, most e-cigarette products contain and emit numerous potentially toxic substances.
Effect of E- Cigarettes on Individual Health
E –Cigarettes and Cardiovascular Disease

E –Cigarettes increase cardiovascular disease

- True
- False
- Insufficient data
E–Cigs and Cardiovascular disease

In vitro studies have shown
Human vascular endothelial cells show increased reactive oxygen species with e-cigarette extract compared with controls (Anderson et al., 2016).

Mice exposed to e-cigarette aerosol for several weeks showed increased levels of oxidative stress, macrophage-mediated inflammation, and inflammatory cytokines including interleukin-6 (Lerner et al., 2015)
Do habitual electronic cigarette users have increased cardiac sympathetic activity and oxidative stress, both risk factors for future adverse cardiac events?

Increased Cardiac Sympathetic Activity and Oxidative Stress in Habitual Electronic Cigarette Users: Implications for Cardiovascular Risk

Heart Rate Variability During Controlled Breathing

Figure 3. Oxidative Stress
Low-density lipoprotein oxidizability, indicative of susceptibility of apoB-containing lipoproteins to oxidation, was significantly increased in e-cigarette users (n = 12) compared with nonuser (n = 18) control participants (mean [SEM], 3801.0 [415.7] U vs 2413.3 [325.0] U, $P = .01$), consistent with increased oxidative stress.
E–Cigarettes and Cardiovascular Disease

• In otherwise healthy, habitual e-cigarette users compared with nonsmoking healthy control participants

• HRV components are shifted toward sympathetic predominance and decreased vagal tone, the pattern found in patients with increased cardiovascular risk, including tobacco cigarette smokers

• Systemic oxidative stress is increased

• Abnormalities of both HRV and oxidative stress are directly associated with e-cigarette burden

• Further studies are required to determine whether these risks are similar to those associated with habitual tobacco cigarette use

• Cannot confirm causality on the basis of this single, small study

• Further research into the potential adverse cardiovascular health effects of e-cigarettes is warranted
E–Cigarettes and Cardiovascular Disease

E–Cigarettes increase cardiovascular disease

- Insufficient data

- There is substantial evidence that e-cigarette aerosols can induce acute endothelial cell dysfunction
- Long-term consequences and outcomes on these parameters with long-term exposure to e-cigarette aerosol are uncertain
E –Cigarettes and Respiratory Disease

E-cigarettes are considered harmful to people with lung disease

- True
- False
- Insufficient data
E–Cigarettes and Respiratory Disease
COPD

• Results are unclear about whether use of e-cigarettes as a substitute for combustible tobacco use in people with COPD may be beneficial, neutral, or harmful
E –Cigs and Respiratory Disease
COPD

Harm may occur

If e-cigarette use prevents the smoker from quitting entirely and instead prolongs the use of combustible tobacco products through dual use

If single use of an e-cigarette as a substitute for combustible tobacco cigarettes causes additional airway inflammation in already damaged lungs
E-Cigarettes and Respiratory Disease

COPD

Benefit may occur

If the use of e-cigarettes by a smoker with COPD can reduce use of combustible tobacco products and can decrease lung inflammation secondary to the reduction of exposure to toxicants found in combustible tobacco smoke but not e-cigarettes,

Individuals with COPD who failed or who are resistant to conventional cessation strategies may be more willing to use e-cigarettes to quit smoking
E Cigarettes and Harm reduction

Evidence for harm reduction in COPD smokers who switch to electronic cigarettes

Riccardo Polosa\textsuperscript{1,2,3,\dagger}, Jaymin Bhagwanji Morjaria\textsuperscript{4,\dagger}, Pasquale Caponnetto\textsuperscript{1,2}, Umberto Prosperini\textsuperscript{5}, Cristina Russo\textsuperscript{6}, Alfio Pennisi\textsuperscript{7} and Cosimo Marcello Bruno\textsuperscript{1,3}
A significant reduction in COPD exacerbations was reported in the COPD EC user group.

COPD symptoms and ability to perform physical activities improved.
E Cigarettes and Harm reduction in COPD

**Improvement in FEV1**

**COPD assessment test scores**
E cigarettes  Harm Reduction COPD

• Regular ECs use may help smokers with COPD attenuate conventional cigarette consumption or remain abstinent, as well as improve subjective and objective COPD outcomes

• The potential role of the e-cigarette category for smoking cessation and/or harm reduction in COPD requires confirmation from larger prospective studies
E-Cigs and Respiratory Disease

Asthma

• Adolescents with asthma—who use e-cigarettes may be more likely to have an increase in respiratory symptoms and exacerbations compared with non-users by one cross-sectional study (Cho and Paik, 2016)
E-Cigarettes – Harm reduction

Asthma

Effect of Smoking Abstinence and Reduction in Asthmatic Smokers Switching to Electronic Cigarettes: Evidence for Harm Reversal

Forced expiratory volume (FEV1)  Asthma control Questionnaire (ACQ) score

Riccardo Polosa et al

E -Cigs and Respiratory Disease

• There is limited evidence for improvement in lung function and respiratory symptoms among adult smokers with asthma who switch to e-cigarettes completely or in part (dual use)
E–Cigs and Respiratory Disease
Cystic Fibrosis

• Nicotine exposure from e-cigarette use could potentially cause a higher rate of respiratory symptoms in CF patients if nicotine causes dysregulation of CFTR in the airways
E –Cigarettes and Respiratory Disease

E-cigarettes are considered harmful to people with lung disease

- True
- False
- Insufficient data
- It depends- Lung disease, single or dual use, Harm reduction
E –Cigarettes and Cancer

E–cigarette use increases the incidence of cancer

- True
- False
- Insufficient data
Principal component analysis of top 2,000 genes by median absolute deviation

E-Cigarettes and Cancer

There is **substantial evidence** that some chemicals present in e-cigarette aerosols are capable of causing DNA damage and mutagenesis from formation of reactive oxygen species/oxidative stress.

This supports the biological plausibility that long-term exposure to e-cigarette aerosols could increase risk of cancer and adverse reproductive outcomes.

Whether or not the levels of exposure are high enough to contribute to human carcinogenesis remains to be determined.
E –Cigarettes and Cancer

• A systematic review of the current body of evidence relevant to the potential association between electronic cigarette use and cancer leads to the clear conclusion that the present body of evidence is simply too sparse to permit meaningful inferences to be drawn about either cancer or intermediate cancer endpoints
Public Health Implications of E-Cigarettes
E Cigarettes - Dependence and Abusability

Use of E cigarettes increases nicotine dependence

- True
- False
E Cigarettes
Dependance and Abusability

• Nicotine is the principal pharmacological agent that causes dependence on combustible tobacco cigarettes (Benowitz, 2008)

• Because nicotine is delivered via a pulmonary route, the speed, efficiency, and magnitude of nicotine delivered in “bolus” form produces a higher addiction potential of nicotine relative to other nicotine-delivery devices with slower pharmacokinetics
E Cigarettes - Dependance and Abusability

• There is evidence that e-cigarette use results in symptoms of dependence on e-cigarettes.
E Cigarettes
Dependence and Abusability

Reward Responses

FIGURE 8-3 Subjective reward responses for the nicotine e-cigarette and the placebo (non-nicotine) e-cigarette.


Distribution of tobacco dependence among each tobacco product

E Cigarettes
Dependance and Abusability

• There is moderate evidence that risk and severity of dependence are lower for e-cigarettes than combustible tobacco cigarettes.
• Whether e-cigarettes cause dependence and what the relative magnitude of risk is relative to combustible tobacco cigarettes are questions that cannot be answered solely by the translation of knowledge about nicotine and combustible cigarettes and necessitate a review of the empirical evidence.
• Furthermore, given the wide variety of products that may alter the nicotine delivery and sensory experience of e-cigarettes, it is plausible that variations in e-cigarette product characteristics affect risk of dependence.
E- cigarettes and smoking uptake
Patterns of Use Among youth and young Adults

E- Cigarettes increase the likelihood of smoking initiation
- True
- False
Patterns of Use among Youth and young Adults

Four distinct tobacco product use states
- no use
- e-cigarette only
- Combustible tobacco cigarette only
- Dual use

Each may have unique health consequences
Public Health implications of E Cigarettes

Smoking uptake -
E- Cigarettes -Smoking Initiation among Teenagers and Young Adults

Meta-analysis of adjusted odds of current (past 30-day) combustible tobacco cigarette smoking at follow-up among non-current combustible tobacco cigarette smokers at baseline and current e-cigarette users at baseline compared with non-current e-cigarette users at baseline.

<table>
<thead>
<tr>
<th>Source</th>
<th>Probability of Past 30-Day Cigarette Smoking, %</th>
<th>Unadjusted OR (95% CI)</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unger et al, 23 2016</td>
<td>Past 30-Day e-Cigarette Users: 26.2; Non-Past 30-Day e-Cigarette Users: 7.0</td>
<td>4.71 (2.27-9.77)</td>
<td>3.32 (1.55-7.11)</td>
</tr>
<tr>
<td>Hornik et al, 24 2016</td>
<td>Past 30-Day e-Cigarette Users: 19.0; Non-Past 30-Day e-Cigarette Users: 2.0</td>
<td>11.18 (5.41-23.13)</td>
<td>5.43 (2.59-11.38)</td>
</tr>
<tr>
<td>Total</td>
<td>Past 30-Day e-Cigarette Users: 21.5; Non-Past 30-Day e-Cigarette Users: 4.6</td>
<td>5.68 (3.49-9.24)</td>
<td>4.28 (2.52-7.27)</td>
</tr>
</tbody>
</table>

Heterogeneity: $\tau^2 = 0.00; \chi^2 = 0.83; P = .36; I^2 = 0\%$

Test for overall effect: $z = 5.37; P < .001$

Trajectories of E-Cigarette

Krysten W. Bold, PhD, Grace Kong, PhD, Deepa R. Camenga, MD, Patricia Simon, PhD, Dana A. Cavallo, PhD, Meghan E. Morean, PhD, Suchitra Krishnan-Sarin, PhD
Relationships between past-month cigarette and e-cigarette use among youth across 3 longitudinal waves (N = 808).

[B = 2.88 SE = .59**

B = 1.96 SE = .56**

B = 1.35 SE = .37**

B = 1.94 SE = .29**

B = 2.12 SE = .45**

B = .70 SE = .56

B = .64 SE = .46

Wave 1

Wave 2

Wave 3

Cigarette use

Cigarette use

Cigarette use

E-cigarette use

E-cigarette use

E-cigarette use

Time

Krysten W. Bold et al. Pediatrics 2018;141:e20171832
Among youth cigarette experimenters, using e-cigarettes was positively and independently associated with future onset of current established smoking, suggesting that e-cigarettes do not divert from, and may encourage, cigarette smoking in this population.
Table 2. Leading Reasons for Noncigarette Tobacco Product Use Among Past 30-Day Tobacco Users, by Product—Population Assessment of Tobacco and Health Study Youth Respondents Aged 12-17 Years, 2013-2014a,b

<table>
<thead>
<tr>
<th>Reasons for Use</th>
<th>% (95% CI)</th>
<th>Any Cigars (n = 340)</th>
<th>Hookahs (n = 226)</th>
<th>Smokeless Tobacco (n = 180)</th>
<th>Snus Pouches (n = 647)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I use [product] because I come in flavors I like</td>
<td>81.5 (77.9-85.0)</td>
<td>73.8 (68.2-79.4)</td>
<td>78.9 (73.4-84.3)</td>
<td>69.3 (62.6-76.0)</td>
<td>67.2 (55.7-78.6)</td>
</tr>
<tr>
<td>I use [product] because they are affordable</td>
<td>47.8 (42.9-52.6)</td>
<td>58.2 (52.7-63.6)</td>
<td>43.7 (36.5-51.0)</td>
<td>60.6 (52.6-68.6)</td>
<td>45.5 (32.1-58.8)</td>
</tr>
<tr>
<td>I use [product] because I can smoke them at times when or in places smoking cigarettes isn’t allowed</td>
<td>58.9 (54.1-63.7)</td>
<td>10.9 (7.1-14.8)</td>
<td>30.8 (24.1-37.5)</td>
<td>69.7 (63.3-76.0)</td>
<td>70.7 (58.7-82.7)</td>
</tr>
<tr>
<td>I use [product] because I like socializing while using them</td>
<td>40.3 (34.5-45.8)</td>
<td>57.0 (51.7-62.4)</td>
<td>79.6 (74.6-84.5)</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>I use [product] because it doesn’t bother non-tobacco users</td>
<td>53.9 (48.1-59.8)</td>
<td>NA</td>
<td>NA</td>
<td>47.7 (40.4-55.0)</td>
<td>50.4 (39.7-61.2)</td>
</tr>
<tr>
<td>I use [product] because they might be less harmful than cigarettes</td>
<td>79.1 (75.2-83.0)</td>
<td>29.9 (25.3-34.5)</td>
<td>60.0 (53.9-67.3)</td>
<td>51.4 (44.3-58.4)</td>
<td>30.9 (24.3-40.0)</td>
</tr>
<tr>
<td>I use [product] because they might be less harmful to people around me than cigarettes</td>
<td>78.1 (74.3-81.8)</td>
<td>NA</td>
<td>NA</td>
<td>68.3 (62.1-74.6)</td>
<td>51.4 (38.7-64.2)</td>
</tr>
<tr>
<td>I use [product] because they don’t smell</td>
<td>58.7 (54.2-63.2)</td>
<td>NA</td>
<td>NA</td>
<td>33.3 (27.4-39.1)</td>
<td>34.2 (29.1-40.4)</td>
</tr>
<tr>
<td>I use [product] because they help people to quit smoking cigarettes</td>
<td>59.5 (54.6-64.5)</td>
<td>9.9 (6.6-13.2)</td>
<td>24.2 (18.1-30.2)</td>
<td>26.8 (21.2-32.5)</td>
<td>25.1 (15.1-35.4)</td>
</tr>
<tr>
<td>I use [product] because people who are important to me use them</td>
<td>34.9 (30.6-39.2)</td>
<td>28.4 (23.5-33.2)</td>
<td>35.9 (30.3-41.6)</td>
<td>40.7 (32.9-48.6)</td>
<td>28.8 (17.8-39.7)</td>
</tr>
<tr>
<td>I use [product] because people in the media or other public figures use them</td>
<td>36.1 (31.5-40.7)</td>
<td>30.7 (26.1-35.4)</td>
<td>28.8 (22.7-35.0)</td>
<td>27.4 (20.8-34.1)</td>
<td>23.8 (13.2-34.5)</td>
</tr>
</tbody>
</table>

Abbreviation: NA, not asked.

a Past 30-day noncigarette tobacco product users were asked to indicate (yes/no) whether particular reasons applied to their use of each specific product. A set of 14 items were asked of e-cigarettes, smokeless tobacco, snus pouches, and dissolvable tobacco users; 10 were asked of cigar and hookah smokers; and a set of 9 were asked of pipe smokers and users of bidis and kretek. Items can be accessed on the PATH Youth Baseline Questionnaire available in the eAppendix in the Supplement.

b Individuals whose response was missing or responded “don’t know” to whether they used products in the past 30 days were excluded from the denominator, including n = 30 for e-cigarettes, n = 9 for cigars, n = 7 for hookahs, n = 15 for smokeless tobacco, and n = 2 for snus pouches. Estimates for pipe, dissolvable tobacco, bidis, and kretek users are not presented owing to small denominators of past 30-day users (n < 50). Cited sample sizes reflect unweighted Ns.

c Past 30-day users whose response was missing or who responded “don’t know” to any item regarding reasons for use were excluded from the denominator (range of missing for each item, by product: n = 0-5 for cigars, n = 0-4 for e-cigarettes and hookahs, n = 0-3 for smokeless tobacco, and n = 0-3 for snus pouches).

d Questions regarding reasons for use were asked separately for past 30-day use of traditional cigar, cigarillos, and filtered cigar. Any respondents reporting past 30-day use of 2 or more types of cigars were asked to report on reasons for use for each type of cigar separately. Responses were aggregated so that if the reason was endorsed for any of the types of cigars, it was counted overall as a positive response.
Patterns of Use Among youth and young Adults

Among youth and young adult e-cigarette users who ever use combustible tobacco cigarettes -

There is moderate evidence that e-cigarette use increases the frequency and intensity of subsequent combustible tobacco cigarette smoking
E- Cigarette and Smoking Cessation Among Adults

E–Cigarette use is an effective smoking cessation strategy

- True
- False
E- Cigarettes
Smoking Cessation Among Adults

• Do E-cigarettes help smokers quit smoking combustible tobacco cigarettes

• Are e-cigarettes effective smoking cessation aids compared with no treatment, a placebo treatment (usually a non-nicotine–containing e-cigarette), or an FDA-approved smoking cessation aid such as a nicotine replacement product, varenicline, or bupropion

• What is the impact of the availability of e-cigarettes on population smoking cessation rates
Conceptual framework of smoking cessation and e-cigarette use

- **Cigarette Only**
  - 1b = continue combustible
- **Cigarette Only**
  - 1c = relapse
- **Dual Use**
  - 3c = relapse
- **Dual Use**
  - 3a = sustain both
- **E-cigarette Only**
  - 2b = sustain nicotine
- **E-cigarette Only**
  - 2a = quit nicotine
- **No Use**
  - 2d = quit all

Relapse = return to any combustible tobacco use
Quit all = quit combustible + nicotine

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Electronic cigarettes for smoking cessation: a Randomized controlled trial

Dr Christopher Bullen, MBChB, Colin Howe, PhD, Murray Laugesen, MBChB, Hayden McRobbie, MBChB, Varsha Parag, MSc, Jonathan Williman, PhD, Natalie Walker, PhD

The Lancet 2013 382, 1629-1637 DOI: (10.1016/S0140-6736(13)61842-5)
E- Cigarettes
Smoking Cessation

There is moderate evidence from randomized controlled trials that e-cigarettes with nicotine are more effective than e-cigarettes without nicotine for smoking cessation.

There is insufficient evidence from randomized controlled trials about the effectiveness of e-cigarettes as cessation aids compared with no treatment or to Food and Drug Administration–approved smoking cessation treatments.

While the overall evidence from observational trials is mixed, there is moderate evidence from observational studies that more frequent use of e-cigarettes is associated with an increased likelihood of cessation.

Overall, there is limited evidence that e-cigarettes may be effective aids to promote smoking cessation.
E- Cigarettes
Smoking Cessation

While scientifically valuable, this evidence does not address a question that is more relevant to public health: how do e-cigarettes with or without nicotine compare to proven FDA-approved cessation aids or to no specific treatment among smokers who are trying to quit?

Without replication, this trial by itself provides insufficient evidence at present to support a conclusion of the relative effectiveness of e-cigarettes versus other cessation aids among smokers who are motivated to quit. This is a question of critical public health importance that deserves priority for federal funding agencies.

A separate key question for public health impact is whether the availability of e-cigarettes induces more smokers to try to quit, because smokers perceive e-cigarettes to be a more appealing option than FDA approved cessation aids.
E cigarettes and Harm Reduction

Reduction in toxic substances

Urinary metabolite levels for selected toxins and carcinogens, by group

Changes in select carcinogen levels over 2 weeks of electronic cigarette use among 20 smokers (mean — SD).

Hecht and colleagues (2015)

Shahab and colleagues (2017)
E Cigs and Harm reduction

• There is **substantial evidence** that completely switching from regular use of combustible tobacco cigarettes to e-cigarettes results in **reduced** short-term adverse health outcomes in several organ systems.

• There is **conclusive evidence** that completely substituting e-cigarettes for combustible tobacco cigarettes reduces users’ exposure to numerous toxicants and carcinogens present in combustible tobacco cigarettes.
E-Cigarettes
Injuries and Poisonings

There is evidence that e-cigarette devices can explode and cause burns and projectile injuries. Such risk is significantly increased when batteries are of poor quality, stored improperly, or modified by users.

There is conclusive evidence that intentional or accidental exposure to e-liquids (from drinking, eye contact, or dermal contact) can result in adverse health effects including but not limited to seizures, anoxic brain injury, vomiting, and lactic acidosis.

There is conclusive evidence that intentionally or unintentionally drinking or injecting e-liquids can be fatal.
Research Needs

1. Research on the mechanisms through which e-cigarette use affects combustible tobacco cigarette smoking both ever use among youth and quitting, among current combustible tobacco cigarette smokers.

2. Research on potential harm reduction to bystanders exposed involuntarily to tobacco smoke after secondhand or third hand exposure to combustible tobacco smoke is replaced by secondhand or third hand exposure to emissions of e-cigarettes.

3. Study the effects of carrier solvents and additives, including flavor ingredients and device characteristics.

4. Study the stability of e-liquid ingredients when heated, identify potential by-products of thermal degradation and of compounds that were not initially present in the e-liquid, and ascertain determinants of change in aerosol composition.

5. Study the impact of e-cigarette use on indoor air quality and biomarkers of secondhand e-cigarette exposure in scenarios and exposure surveys that are relevant for the populations exposed.

6. Establish procedures to rapidly evaluate changes to products currently on the U.S. market, focusing on device designs, design evolution.
What clinician should know

• E- Cigarettes are not harmless
• There is still a significant knowledge gap – cancer risk, cardiovascular disease
• E-cigarettes have the potential to benefit adult smokers if used as a complete substitute for regular cigarettes and other smoked tobacco products (Harm reduction)
• E-cigarettes are not safe for youth, young adults, pregnant women, or adults who do not currently use tobacco products
• E-cigarettes are associated with future onset of cigarettes smoking among youth
• Knowledge gap whether e-cigarettes are effective for quitting smoking and should be offered as Nicotine replacement in smoking cessation interventions
• Additional research can help understand long-term health effects
References


• https://www.cdc.gov/tobacco/basic_information/e-cigarettes/index.htm


• https://doi.org/10.1371/journal.pone.016732