E-cigarettes: An Emerging Public Health Challenge

October 20, 2015
Patterns of E-cigarette Use Among U.S. Adults and Youth

Brian A. King, PhD, MPH
Deputy Director for Research Translation
Office on Smoking and Health
National Center for Chronic Disease Prevention and Health Promotion
Electronic Nicotine Delivery Systems (ENDS)

At least 450 brands

- E-Cigarettes
- E-Cigars
- E-Pipes
- Hookah Pens
- Vape Pens
- E-Hookahs
Types of E-Cigarettes

“Minis” or “Cigalikes”
Smaller and not customizable by user

“Mid-Sized”

“Tanks” or “Mods”
Larger and customizable by user

Nicotine content can vary across e-cigarette products
Anatomy of an E-Cigarette

User inhales aerosol

Battery (power source)

Atomizer (heats the solution)

Liquid Cartridge (holds a liquid nicotine, propylene glycol, and/or glycerin solution)
U.S. Adult Per Capita Cigarette Consumption and Major Smoking and Health Events, 1900–2013

Adapted from Warner 1985 with permission from Massachusetts Medical Society, ©1985
U.S. Department of Health and Human Services 1989; Creek et al. 1994; U.S. Department of Agriculture 2000;
U.S. Census Bureau 2013; U.S. Department of the Treasury 2013
Best Practices to Prevent and Reduce Tobacco Use

- Counteract industry marketing with sustained, high-impact mass media campaigns
- Raise the price of tobacco products
- Provide access to tobacco cessation treatment
- Fully fund statewide tobacco control programs
- Extend comprehensive smoke-free indoor protections
Family Smoking Prevention and Tobacco Control Act (2009)

- Granted the Food and Drug Administration (FDA) authority to regulate the manufacturing, marketing, and sale of tobacco products

- "Tobacco product" is any product made or derived from tobacco that is intended for human consumption

  - The nicotine in e-cigarettes is typically derived from tobacco

- In April 2014, FDA proposed to regulate e-cigarettes as tobacco products

"This shift in patterns of tobacco use could have a number of potential impacts, ranging from the positive effect of accelerating the rate at which smokers quit smoking cigarettes completely to a negative effect of slowing down the decrease in the use of all tobacco products, especially cigarettes."
Ever Use (Even Just One Time) of E-cigarettes Has Increased Among Current and Former Smokers


Current Cigarette Smoker

Former Cigarette Smoker

Never Cigarette Smoker

Current Smoker = Smoked at least 100 cigarettes in lifetime, and now smokes “every day” or “some days”
Former Smoker = Smoked at least 100 cigarettes in lifetime, and now smokes “not at all”
Never Smoker = Not smoked at least 100 cigarette in lifetime

King BA, Patel R, Nguyen KH, Dube SR. Nicotine Tob Res 2015
Current Use (At Least Once in Past 30 Days) of E-cigarettes is Highest Among Current Smokers


<table>
<thead>
<tr>
<th>Status</th>
<th>2010-2011</th>
<th>2012-2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never Smoker</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Former Smoker</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Current Smoker</td>
<td>1.3</td>
<td>9.4</td>
</tr>
</tbody>
</table>

76.8% of current e-cigarette users were also current cigarette smokers (i.e., dual users) in 2012/2013

Current Smoker = Smoked at least 100 cigarettes in lifetime, and now smokes “every day” or “some days”
Former Smoker = Smoked at least 100 cigarettes in lifetime, and now smokes “not at all”
Never Smoker = Not smoked at least 100 cigarette in lifetime

King BA, Patel R, Nguyen KH, Dube SR. Nicotine Tob Res 2015
Continued Rise In U.S. High and Middle School Students Reporting Ever Use of E-cigarettes

Percent of *Ever Use* of E-cigarettes Among U.S. High and Middle School Students, 2011-2014

*Used, even just one time
Centers for Disease Control and Prevention, U.S. Food and Drug Administration. 2011-2014 National Youth Tobacco Survey
More U.S. High and Middle School Students Are Currently Using E-cigarettes

Percent of *Current Use* of E-cigarettes Among U.S. High and Middle School Students, 2011–2014

*Used an e-cigarette in past 30 days
E-cigarettes and Nonsmoking Youth

Among nonsmoking youth, those that have ever used e-cigarettes have greater intentions to smoke conventional cigarettes than those who have never used e-cigarettes.

Among Youth, E-cigarette Use May Lead to Conventional Cigarette Use

- High school students who had never smoked but reported ever using e-cigarettes at baseline were 2.7 times more likely to start using combustible tobacco after 1 year compared with high school students who never used e-cigarettes.

- U.S. adolescents and young adults who had never smoked but used e-cigarettes at baseline were 8.3 times more likely to progress to cigarette smoking after 1 year than nonusers of e-cigarettes.

Leventhal AM, Strong DR, Kirkpatrick MG, et al. JAMA 2015
Among U.S. middle and high school students who currently use* e-cigarettes, 63% have used flavored e-cigarettes or – 1.58 million U.S. youth

*Used an e-cigarette in past 30 days
Corey CG, Ambrose BK, King BA, and Apelberg BJ. MMWR October 2015
Conclusions

- E-cigarettes are currently unregulated in the U.S.
  - Product landscape is rapidly growing and diversifying

- Among adults, e-cigarette use has increased steadily
  - Most adult users are current or former cigarette smokers

- Among youth, an alarmingly sharp increase in e-cigarette use has occurred since 2011
  - Emerging data suggest e-cigarette use might lead to subsequent combustible tobacco smoking among youth
  - In 2014, 1.58 million current youth e-cigarette users had used a flavored e-cigarette
Health Consequences of Electronic Cigarettes

Jonathan M. Samet, MD, MS
Distinguished Professor and Flora L. Thornton Chair,
Department of Preventive Medicine,
USC Keck School of Medicine
Key Aerosol Components

- **Aerosol vehicle**—mainly propylene glycol and some vegetable glycerin
- **Nicotine**—delivered at varying concentrations and doses, depending on the device and its operation
- **Flavorings**—a variety of flavorings are used
- **Other contaminants with known potential risks**
  - Tobacco-specific nitrosamines
  - Metals
  - Formaldehyde
  - Acrolein
What Do Electronic Cigarettes Deliver?

- An aerosol composed of droplets of the vehicle and its components
- The aerosol particles are in the size range that penetrates into the lung
- Materials in deposited particles reach the cells of the airways
- Some components (e.g., nicotine) move across the lining of the lung and enter the circulation
The evidence is sufficient to infer that

1. At high-enough doses, nicotine has acute toxicity

2. Nicotine activates multiple biological pathways through which smoking increases risk for disease

3. Nicotine exposure during fetal development, a critical window for brain development, has lasting adverse consequences for brain development

4. Nicotine adversely affects maternal and fetal health during pregnancy, contributing to multiple adverse outcomes such as preterm delivery and stillbirth
The evidence is suggestive that
- Nicotine exposure during adolescence, a critical window for brain development, may have lasting adverse consequences for brain development
- Adolescents have an increased risk because their brains are still developing and are particularly sensitive to nicotine

Nicotine has adverse effects on health across the full life course—extending from gestation through adulthood

From the 1988 Surgeon General’s Report:
“Nicotine is the drug in tobacco that causes addiction.”

www.surgeongeneral.gov/library/reports/50-years-of-progress/
Nicotine Poisoning Has Risen

Calls to Poison Centers for Exposures to Cigarettes and Electronic Cigarettes — U.S., September 2010–December 2014

www.cdc.gov/mmwr/preview/mmwrhtml/mm6313a4.htm and aapcc.org unpublished data
Flavorings

- Numerous flavorings used in electronic cigarettes
- The flavorings are GRAS for ingestion, but not for inhalation

GRAS: “Generally recognized as safe” is U.S. Food and Drug Administration (FDA) designation that a substance added to food is considered safe by qualified experts, and so is exempted from the usual Federal Food, Drug, and Cosmetic Act (FFDCA) food additive tolerance requirements

www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/ucm061846.htm
Flavoring Is Linked to Permanent Scarring of the Airways in the Lungs

- One flavoring, diacetyl, is linked to bronchiolitis obliterans
  - Scarring of the bronchioles

- Some flavorings in use are structurally similar to diacetyl

MMWR, 2007 Apr 27;56(16)

Current employee protective wear for working with diacetyl
Adolescent E-cigarette Use Associated with Increased Risk of Chronic Cough

- Among 2,100 11–12th graders
  - 502 students reported ever use of e-cigarettes
    - 212 reported no history of combustible tobacco use (never smokers)
  - 196 students reported current use of e-cigarettes
    - 78 reported no history of combustible tobacco use (never smokers)
- Ever users had 2-fold increased risk for bronchitic symptoms (i.e., chronic cough)
- The more often current users used e-cigarettes, the greater their risk for bronchitic symptoms
- Even for e-cigarette users who never smoked, there was 1.6 increased risk for bronchitic symptoms

Electronic Cigarettes and Smoking Cessation

- Anecdotes and testimonials are abundant
- Very few clinical trials conducted to date
- Available evidence from recent Cochrane systematic review suggests
  - Electronic cigarettes may help to reduce the number of cigarettes smoked
  - Little evidence on efficacy compared with proven cessation therapies

## E-cigarette Risk Assessment

<table>
<thead>
<tr>
<th>Potential Harms</th>
<th>Potential Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For youth</strong></td>
<td></td>
</tr>
<tr>
<td>- Increased exposure to nicotine and greater initiation of conventional cigarettes</td>
<td>- Reduced disease risk for those who switch to e-cigarettes, and reduce or quit cigarettes</td>
</tr>
<tr>
<td>- Long-term consequences on brain development</td>
<td>- Reduced disease morbidity for those already with heart and lung disease who switch to e-cigarettes, and reduce or quit cigarettes</td>
</tr>
<tr>
<td>- Future disease risks</td>
<td></td>
</tr>
<tr>
<td><strong>For current smokers</strong></td>
<td></td>
</tr>
<tr>
<td>- Slowing cessation</td>
<td></td>
</tr>
<tr>
<td>- Increased disease risk vs. complete cessation</td>
<td></td>
</tr>
<tr>
<td><strong>For former smokers</strong></td>
<td></td>
</tr>
<tr>
<td>- Return to nicotine addiction</td>
<td></td>
</tr>
<tr>
<td><strong>For society and nonsmokers</strong></td>
<td></td>
</tr>
<tr>
<td>- Renormalization of nicotine and smoking</td>
<td></td>
</tr>
<tr>
<td>- Secondhand aerosol exposure</td>
<td></td>
</tr>
</tbody>
</table>
Critical Research Needs

- Surveillance for emergent patterns of e-cigarette use with attention to nicotine addiction
- Monitoring for sentinel events, including nicotine poisoning and respiratory complications
- Toxicological screening of components, particularly flavorings
- Investigation of abuse liability of electronic cigarettes and role of flavorings
- Studies of effects in key possibly susceptible groups: adolescents, people with heart and lung disease
E-cigarettes in Washington State: On the Front Lines

John Wiesman, DrPH, MPH
Secretary of Health
Washington State Department of Health
A Challenge in Public Health Practice

Public health perspective

- For adults who already smoke, switching to e-cigarettes is probably less harmful than continuing to smoke, but they have to quit smoking cigarettes completely.
- For adults who never smoked or are former smokers, or are pregnant women, e-cigarette use could be harmful to their health.
- For youth, e-cigarette use is unsafe for their health and should not be done at all.

Challenges to simultaneously implement in terms of the public policy of e-cigarette regulation.
Washington Healthiest Youth Survey Results

Prevalence of past 30 day e-cigarette/vaping, cigarette and dual use among youth by grade

- **E-cig only**: 3.6% (12th grade)
- **Dual use**: 9.0% (12th grade)
- **Cigarette only**: 3.6% (12th grade)
- **E-cig only**: 14.1% (12th grade)
- **Dual use**: 12.2% (10th grade)
- **E-cig only**: 5.7% (10th grade)
- **Cigarette only**: 1.2% (8th grade)
- **Dual use**: 2.7% (8th grade)

Data source: Washington State Healthy Youth Survey, 2014
www.doh.wa.gov/DataandStatisticalReports/DataSystems/HealthyYouthSurvey
Reduce Impact on Youth

**Goal**: Protect our young people from the impact of e-cigarettes and tobacco

**Strategy**: Reduce supply and demand

- Adequate funding
- Health promotion and education
- Policy, systems, and environment changes
Reduce Demand: Education

WA Tobacco Control Funds (2000–2015)

Resources severely limited

Reduce Demand: Public Education and Health Promotion

Most Youth Rise Above the Influence

Send a selfie showing how you live drug free and enter to win Seahawks tickets or other prizes.

Contest rules at 206rising.org

NOPE.
Pierce County isn’t fooled by e-cigarettes.

THINK AGAIN, PIERCE COUNTY.
E-cigarettes are harmful, just like cigarettes.

Tacoma-Pierce County Health Department, Tacoma, WA

www.206rising.org/
www.thinkagainpiercecounty.com/
Impact of raising taxes on cigarettes has been shown, but impact on e-cigarettes is not known.

In Washington:
- Pack of cigarettes costs $8.31
- E-cigarettes – starter kit costs $50-200
- On average, liquid nicotine costs half as much as cigarettes

Reduce Demand: Tax E-cigarettes

State Laws Enacted to Tax ENDS – September 30, 2015

- No Tax on E-cigarettes (45 states)
- Tax on E-cigarettes (5 states plus DC)

ENDS: Electronic nicotine delivery systems
CDC Office on Smoking and Health
State Laws Enacted to Require a License for Over-the-Counter Retail Sales of ENDS – September 30, 2015

Reduce Supply: License Retailers

ENDS: Electronic nicotine delivery systems
CDC Office on Smoking and Health
State Laws Prohibiting Sales of ENDS to Minors* – September 30, 2015

- Do Not Prohibit ENDS Sales to Minors (4 states plus DC)
- Prohibit ENDS Sales to persons under age 18 (45 states)
- Prohibit ENDS Sales to persons under age 19 (4 states)
- Prohibits ENDS Sales to persons under age 21 (1 state)

*Minors are defined by statute as persons <18 years, except in four states (Alabama, Alaska, New Jersey, and Utah) where they are defined as persons aged <19 years.

ENDS: Electronic nicotine delivery systems

Reduce Supply: Raise the Legal Age to Purchase

CDC Office on Smoking and Health
Additional Policy Choices

- Require child-resistant containers
- Require warnings on bottles or points of sale
- Prohibit specific flavors
  - (New York proposal – only tobacco, menthol, mint, wintergreen)
- Prohibit indoor and public use

www.clark.wa.gov/public-health/community/tobaccofree/publicsmoking.html
Prohibit Smoking and Use of E-cigarettes in Public and Indoor Places

State Laws Prohibiting Smoking and Use of ENDS in Indoor Areas of Private Worksites, Restaurants and Bars – May 2015

ENDS: Electronic nicotine delivery systems
CDC Office on Smoking and Health
Rapidly Emerging Challenge

- Sale of e-cigarettes pre-loaded with THC (marijuana) in states that have legalized or decriminalized the recreational or medical use of marijuana
- Devices look similar to e-cigarettes

THC: Tetrahydrocannabinol, the psychoactive component of marijuana
WA State’s Attempt at Comprehensive Legislation

Washington Governor’s proposal:
- License retailers
- Require labeling of nicotine and other contents
- Restrict displays, OTC sales, and flavors
- Prohibit internet sales
- Prohibit use on school grounds
- Ensure child-safe packaging
- Tax vapor products

Washington Attorney General’s proposal:
- Raise age of purchase to 21

Proposals failed in 2015, will continue in 2016
Attaining a Tobacco-Free Generation and the Emergence of E-Cigarettes

Matthew L. Myers
President, Campaign for Tobacco-Free Kids
Progress Towards Creating a Tobacco-Free Generation

- There has been substantial progress both in reducing youth initiation and use of cigarettes
- Reduction in cigarette use has been accompanied by a change in attitudes among youth
  - Smoking is no longer cool, chic or sexy
- Progress in places that have adopted CDC’s Best Practices demonstrate that available tools can drive youth tobacco use even lower – much lower
Therefore, ENDS are not critical to achieving a Tobacco-Free Generation.

The issue is:

ARE THEY A THREAT TO ACHIEVING THAT GOAL?
Prior to the Emergence of E-cigarettes, Youth Smoking Rates Were Falling

Youth Smoking Rates as Reported by 9–12th Graders, 1997–2013

Current cigarette use: Smoked cigarettes on at least 1 day during the 30 days before the survey
Current frequent cigarette use: Smoked cigarettes on 20 or more days during the 30 days before the survey
Youth Risk Behavior Surveillance System
Prior to the Emergence of E-cigarettes, Amount and Frequency of Use Were Falling

Use of Cigarettes as Reported by 12th Graders, 1997–2014

30-Day: Ever used in past 30 days
www.monitoringthefuture.org/data/14data.html#2014data-cigs
In 2013, the percentage of cigarette use was higher among adolescents who lived in nonmetropolitan areas (8.4%) than adolescents who lived in metropolitan areas (5.1%).

From 2009 to 2013, the percentage of U.S. adolescents using cigarettes decreased from 9.0% to 5.6%. There were significant decreases for whites, blacks and Hispanics.

National Survey on Drug Use and Health, Center for Behavioral Health Statistics and Quality, SAMHSA, 2009-2013
Evidence that Current Policies Can Reduce Youth Tobacco Use Further

- U.S. youth smoking rates vary from 4.4% to 19.5%
- While the national average is 15.7%
  - 16 states have youth smoking rates under 11%
  - 6 states are already under 10%
    - New York is 7.3%
    - Florida is 6.9%
    - Utah is 4.4%
- Except Utah, the states and cities with the lowest youth smoking rates have had mass media campaigns
  - Sustained
  - Hard-hitting and explicit
  - Creative

Disapproval of Cigarette Use Increased in Youth After Marketing Restrictions and Other Changes

Monitoring the Future, 1975–2014
E-Cigarette Companies Are Copying Big Tobacco’s Playbook

Here's how →
1. Celebrity Spokespeople

They have celebrity spokespeople
Like cigarette ads of old, television, online and print ads for e-cigarettes feature catchy slogans and celebrity endorsers

Stephen Dorff's Rise From the Ashes- Brought to you by blu Cigs
www.youtube.com/watch?v=VZishwAt_RM

tobacco.stanford.edu/tobacco_main/main.php
... and TV personalities

... Jenny McCarthy for blu eCigs

www.youtube.com/watch?v=A5rBDwliN8E  tobacco.stanford.edu/tobacco_main/main.php
Their magazine ads feature rugged men ...
These ads feature today’s equivalents of the Marlboro Man and the Virginia Slims woman, depicting e-cigarette use as masculine, sexy or rebellious. E-cigarette ads have appeared in magazines that reach millions of teens, including Rolling Stone, and Sports Illustrated.
Like cigarette companies have long done, e-cigarette makers portray use of their products as sexually attractive.

3. They know sex sells
Selection of Magazines

2014 Sports Illustrated Swimsuit Edition
Offering Free Samples

www.facebook.com/NJOYecigs, May 19, 2014

Handing out free samples at the New York City Gay Pride Parade, 2013
4. They sponsor sports ...

Cigarette sponsorship of sports has been prohibited since 1998
Especially Sports that Appeal to Youth

www.facebook.com/NJOYecigs,
May 19, 2014
For decades, tobacco companies used sponsorships of sports and entertainment events, especially auto racing and music festivals, to promote cigarettes to huge audiences, including kids. Cigarette sponsorships are now banned, but e-cigarette brands have auto racing sponsorships of their own.
5. Their products come in sweet flavors

A 2009 federal law banned fruit- and candy-flavored cigarettes, but many e-cigarette companies gleefully pitch similar flavors …
Blucigs #SundayFunday: what’s better during a long weekend than a #PinaColada with a side of Piña Colada? Not much. #bluNation #blucigs #MybluFlavor #Relax

Jaleasa712 #blunation
Tygerlily18 make in disposable #blunation
Underdeeconstruction #blunation
Kgberry09 #blunation
Younggog50 #blunation
Mikestory65 #blunation #newflavor
Resemblance to liquid candy products:
6. They use cartoons

The website for Blu e-Cigs has featured a cartoon pitchman named “Mr. Cool” reminiscent of the Joe Camel cartoon character that so effectively marketed cigarettes to kids in the 1990s and was prohibited in the Master Settlement Agreement.
Marketing of ENDS vs. FDA Approved NRT

- A comparison of marketing for nicotine replacement therapy (NRT) with marketing for ENDS

- It is possible to
  - Target smokers without a major impact on youth
  - Using images that appeal to adult smokers for the purpose of encouraging or assisting them to quit smoking without appealing to youth
Magazine Advertisement of NRT

Text on patch:
"I wear it because I'm a 69-year old basketball player. And I plan on being an 80-year old basketball player."

Bottom Text:
"When you decide that smoking is something you’d like to be rid of, you need the power to just get it done. Each NicoDerm CQ patch helps fight cravings all day. And is even strong enough to fight cravings while you sleep. When you're serious, make a statement. Get serious. Get CQ. For more info, Quit.com.”

Bottom text: "Do it for your family. Do it for yourself. Don't do it alone. Give yourself a better chance to quit, with Nicoderm CQ. Just one CQ patch provides a steady stream of medicine to help you fight cravings all day. So instead of spending all your energy on quitting, you can spend it on the people you care about. And with CQ, you'll gradually step down the doses until you're free. Nicoderm CQ. You're not a superhero. You don't have to be."
FDA and E-cigarettes

- Government at every level has a role to play
- 2009 Family Smoking Prevention and Tobacco Control Act:
  - FDA authority over cigarettes, cigarette tobacco, roll-your-own tobacco and smokeless tobacco
- FDA may “deem” other “tobacco products” subject to statute
- FDA announced its intention to assert jurisdiction over e-cigarettes in 2010 but did not issue a “Proposed” Rule until April 25, 2014
- Awaiting Final Rule
FDA – Proposed Sales Rules

- Prohibits sales to persons under 18 and requires age verification by retailers
- Prohibits sales through vending machines except in adult-only facilities
- Bans free samples
FDA Has Authority Over Marketing

Rule does not restrict

- E-Cigarette marketing
- Self-service displays
- Brand sponsorship of athletic and musical events
- Distribution of non-tobacco merchandise with brand logos
- On-line sales
- TV or Internet ads
FDA and Flavorings

- Proliferation of flavored e-cigarette products
- Product standard governing characterizing flavors to prevent flavors that appeal to youth
- If any flavors help smokers quit, industry should demonstrate it scientifically
FDA can develop an effective comprehensive nicotine policy that:

- drives tobacco use from products that are the most lethal to those that are the least harmful
  — and protects our youth
Conclusion

- Difficult to know the impact of current use of e-cigarettes among youth on long term ENDS use or on the use of cigarettes
- However, it is not too early to be concerned that current ENDS marketing practices and the use of flavorings that make these products attractive to youth pose a threat – to the progress that has been made
- Places that have adopted Best Practices have shown that in the absence of ENDS, we do have the ability to create a Tobacco-Free Generation
E-cigarettes: An Emerging Public Health Challenge