E-Cigarettes: The Vapor This Time?

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National Conference on Tobacco and Behavioral Health; The Debate Electronic Cigarettes
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• 2003: Chinese pharmacist, Hon Lik, is credited with conceptualizing and producing the first modern Electronic Cigarette
• **Nicotine Addiction: The Next Generation**
  – Aerosolizes Nicotine Laced Propylene Glycol Alone with Other Chemicals
  – Long Term Health Impact Unknown
  – Potential Life Saving Cessation Device; Actual Promoter of Continued Tobacco Use
  – Explosion in Popularity; Emergence of a New Vaping Subculture
  – Little Regulation
  – The Tobacco Vapor Electronic Cigarette Association estimates that there are more than 3.5 million e-cigarette users in the United States alone. Many more Today
Component Parts E-Cig-a-Likes
E-Cig Tanks
E-Cig Tank Systems; Mods
E-Pens; E-Hookah Pens

- Cherry, Chocolate,
- Vanilla, Bubblegum
E-Cigars

- Swisher Sweets E-cigars (Swisher International)

Westenberger, 2009; Goniewicz et al, 2013
New Bluetooth E-Cigarette Lets You Vape AND Receive Calls, Listen to Music
The E-Cigarette Explosion

• Market Size Continues to Increase
  – retail sales are over $1B currently;
  – ~$1.8B by the end of 2013;
  – U.S. comprises 30% of the $6B global market

• E-cigs could surpass consumption of conventional cigs within the next decade (by 2023).

(Herzog, 2013)
E-Cigarette Advertising Triples, 2011 to 2012

• “Overall, e-cigarette advertising expenditures across media channels **tripled** from $6.4 million in 2011 to **$18.3 million in 2012**
  – 80 unique brands
  – blu eCigs dominated ad spending, comprising 76.7% of all e-cigarette advertising
  – Highest in Magazines and TV; Lowest in Newspapers
  • (Kim et al., 2014)
E-Cigarette Advertising Doubles, 2012 to 2013

• E-cigarette manufacturers have significantly increased marketing spending, more than doubling expenditures between 2012 and 2013.

  In total, six e cigarette companies spent $59.3 million in 2013 to market e-cigarettes
Vape Shops on the Rise

• The "Starbucks of e-vapor“
  – It is estimated that there are somewhere between 5,000-10,000 vape shops in the U.S.
  – Vapers can hang out, work, socialize and vape
  – Purchase products; sample new ones
  – Eating and Drinking

(Herzog, 2014)
E-Cigarette Explosion: Youth Uptake
Case in Point

• Among Middle and High School Students:
  – E-cigarette use rose from 4.7 percent in 2011 to 10.0 percent in 2012 (ever used)
  – E-cigarette use rose from 1.5 percent to 2.8 percent (past 30 days)
  – In 2012 more than 1.78 million middle and high school students nationwide had tried e-cigarettes
  – 76.3 percent of who used e-cigarettes within the past 30 days also smoked conventional cigarettes in the same period. (MMWR,CDC, 2013)
Youth Use of E-Cigs Growing Worldwide

- Korea; 9.4% ever use and 4.7% past 30 day use. (Lee et al., 2013)
- Poland; 23.5% of Polish teens aged 15-19 had ever used e-cigarettes (Goniewicz and Zielinska-Danch, 2012)
- Latvia; 9.1% of 13-15 year olds are current e-cigarette users (Reddy, 2013)
- Finland; 17% of 13-15 year olds have ever used e-cigarettes (Reddy, 2013)
Enter the tobacco industry

- Lorillard (LO)
  - Acquired the Blu E-Cigs in April 2012 for $135M.

- Reynolds American (RAI)
  - Vuse: Microprocessor Controlled

- Altria Group (MO)
  - MarkTen; May acquire an existing e-cig company

- NJOY (privately held)
  - Ex Surgeon General Carmona; other personnel includes Several Ex-Altria Execs.
  - #2 brand in the c-store channel in terms of dollar sales and #4 in the take-home channel
The Also Rans  (Herzog, 2013)

Change in Shelf Space Allocation Y/Y

Cigarettes  Smokeless  Snus  Cigars  E-Cigs

-20%  0%  20%  40%  60%  80%

-1%  4%  4%  72%

Q1 2013  Q2 2013
E-Cigarette Liquid
E-Cigarette Liquid: The “Juice”

- E-Cigarette Liquid contains:
  - **Nicotine**, extracted from tobacco leaves
    - Large variation in content between and within brands
      (Cheah et al 2012; Trtchounian et al 2011; Goniewicz et al 2013)
    - Lethal if ingested; 60 mg Adult; 6 mg Children
    - Detrimental to fetuses (Martz, 2009)
    - Tobacco specific nitrosamines (TSNAs) (Laugesen, 2008; Westenberger, 2009; Goniewicz et al 2013)
• E-Cigarette Liquid contains:
  – Propylene Glycol - the vapor; the fog
    • FDA approved food additive (humectant, solvent for colors and flavors), cosmetics, and medicines.
    • Short term exposure causes eye, throat, and airway irritation (Wieslander et al 2001; Vardavas et al 2012,)
    • Long term exposure can result in children developing asthma. (Choi et al 2010)
    • Chemical composition changes when heated (Henderson et al, 1981)
E-Cigarette Liquid: The “Juice”

- E-Cigarette Liquid contains:
  - **Glycerin:** A humectant used instead of or in combination with propylene glycol in EC fluids for aerosol production.
  - FDA Approved for ingestion.
  - Slightly hazardous in case of skin and eye contact, ingestion, and inhalation; prolonged exposure may cause organ damage.
  - **Metals**
  - Tin Particles found in E-liquid (Williams et al., 2013)
E-Cigarette Liquid: The “Juice”

- E-Cigarette Liquid contains:
  - Flavorants. Key one Menthol; Candy flavoring
    - Anesthetic effects, mimics bronchial dilatation, increases salivary flow; transbuccal absorption; greater cell permeability
    - Allows the poison to go down easier!

  - 100s of candy flavors; appeals to kids (bubblegum, strawberry, gummy bears, etc.)
  - Exotic for adults (Sex on the Beach, Aces and 8’s)

- Mix your Own (ala roll your own)
Combustion; Heating; Aerosolizing

- Cigarettes burn tobacco at ~ 900° Celsius
- Heated Tobacco Products
- E-Cigarettes aerosolize nicotine laced propylene glycol at 40 – 65° Celsius
E-Cigarette Aerosol Vapor Contains:

- Propylene glycol, glycerol, flavorings, and nicotine, which are found in the e-liquid, are also found in the e-vapor
- Propylene oxide
- Volatile Organic Compounds: Benzene and Toluene
- Carbonyl Compounds: Formaldehyde, acetaldehyde, and acrolein
- Metals: tin, silver, iron, nickel aluminum, sodium, chromium, copper, magnesium, manganese, lead, potassium and silicate nanoparticles
- Tobacco specific nitrosamines (TSNAs) carcinogenic compounds found in tobacco and tobacco smoke.
As Battery Voltage Increase, Toxins Increase

• On Average, Toxins were 13 – 807 Fold Lower than Tobacco Cigarettes

• **However**, when Voltage was Gradually Increased from 3.2 to 4.8V:
  - 4 to over 200 times increase in formaldehyde, acetaldehyde, and acetone levels
  - The levels of formaldehyde were in the range of levels reported in tobacco smoke

(Kosmider et al., 2014)
E-Cigarettes: The Second Generation

• **1\(^{st}\) Generation:**
  – Cig-a-likes
  – Most Toxins Emitted in the Aerosol Lower than Regular Cigarettes
  – Aerosolizing Temperature 40 – 65c

• **2\(^{nd}\) Generation**
  – Tank Systems; refillables
  – Some Toxins Emitted Approaching Levels found in Regular Cigarettes
  – Aerosolizing Temperatures >65c
Secondhand Exposure to Vapors From Electronic Cigarettes (Czogala et al, 2013)

- The average concentration of nicotine resulting from smoking tobacco cigarettes was 10 times higher than from e-cigarettes ($31.60\pm6.91$ vs. $3.32\pm2.49$ µg/m)
- 7xs more Particulate matter
- Still, in a room of 5 to or more e-cigarette users, nicotine and particulate matter levels are above healthy levels
<table>
<thead>
<tr>
<th>Aerosol Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Propylene glycol</td>
</tr>
<tr>
<td>• glycerin</td>
</tr>
<tr>
<td>• Flavorings (many)</td>
</tr>
<tr>
<td>• Nicotine</td>
</tr>
<tr>
<td>• NNN</td>
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<tr>
<td>• NNK</td>
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<tr>
<td>• NAB</td>
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<tr>
<td>• NAT</td>
</tr>
<tr>
<td>• Ethylbenzene</td>
</tr>
<tr>
<td>• Benzene</td>
</tr>
<tr>
<td>• P,m, xylene</td>
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<tr>
<td>• Toluene</td>
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<tr>
<td>• Acetaldehyde</td>
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<tr>
<td>• Formaldehyde</td>
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<tr>
<td>• Naphthalene</td>
</tr>
<tr>
<td>• Styrene</td>
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<tr>
<td>• Benzo(b)fluoranthene</td>
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<tr>
<td>• Chlorobenzene</td>
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<tr>
<td>• Crotonaldehyde</td>
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<td>• Propionaldehyde</td>
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<td>• Benzaldehyde</td>
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<td>• Valeric acid</td>
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<td>• Hexanal</td>
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<td>• Fluorine</td>
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<td>• Acenaphthene</td>
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<td>• Fluoranthene</td>
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<td>• Benz(a)anthracene</td>
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<td>• Chrysene</td>
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<td>• Retene</td>
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<td>• Benzo(a)pyrene</td>
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<tr>
<td>• Indeno(1,2,3-cd)pyrene</td>
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<tr>
<td>• Benzo(ghi)perylene</td>
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<td>• Acetone</td>
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<td>• Acrolein</td>
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<td>• Silver</td>
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<td>• Nickel</td>
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<td>• Tin</td>
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<td>• Sodium</td>
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<td>• Strontium</td>
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<tr>
<td>• Zinc</td>
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<tr>
<td>• Zirconium</td>
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<tr>
<td>• Cobalt</td>
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</tbody>
</table>

Compounds in **yellow** are from FDA 2012, Harmful and Potentially Harmful Substances – Established List
The Aerosol: It's not just Water Vapor

**E-Cigarette Vapor**
- Concentrations of pollutants less than in cigarettes
- Carcinogens, less than in cigarettes
- Great variation across products; no product standards
- Intermediate and long term health effects unknown
- Maybe safer, but this doesn’t mean safe
“Overall, the e-cigarette is a new source of VOCs and ultrafine/fine particles in the indoor environment. Therefore, the question of “passive vaping” can be answered in the affirmative. However, with regard to a health-related evaluation of e-cigarette consumption, the impact of vapor inhalation into the human lung should be of primary concern” (Schripp, et al., 2012).
Short Term Pulmonary Effects

A team of scientists found that only after 5 minutes of use, e-cigarettes had immediate adverse physiologic effects, similar to some of the effects seen with tobacco smoking, including decreased FeNO. FeNo, or Fractional exhaled Nitric Oxide, shows the retardation of lung function; this measure is often used in assessing persons with asthma (Vardavas, et al., 2012)
Poison center calls involving e-cigarettes

215
Calls per Month

1
Call per Month

September 2010
February 2014
## Calls to California Poison Control Centers Concerning E-Cigs

<table>
<thead>
<tr>
<th>Year</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>4</td>
</tr>
<tr>
<td>2011</td>
<td>12</td>
</tr>
<tr>
<td>2012</td>
<td>19</td>
</tr>
<tr>
<td>2013 thru Feb 2014</td>
<td>155</td>
</tr>
</tbody>
</table>

(F. Lee Cantrell California Poison Control System)
E-Cigs and Cessation: The Promise vs. The Reality: Dual Use

- Proof of concept study in 40 smokers not wanting to quit; Followed up at 24 weeks
  - 33% sustained a 50% reduction in cigarette consumption
  - 13% sustained an 80% reduction in cigarette consumption
  - 23% sustained complete abstinence

In another study comparing three different groups, 2 using different strengths of e-cigarette “juice” and one group not receiving nicotine cartridges, found that “there were significant reductions in Cigs/day comparing baseline to week 52:

- Group A: 19 to 11
- Group B: 21 to 10
- Group C: 22 to 12

(Caponnette, et al., 2013).
E-Cigs and Cessation: The Promise vs. The Reality: Dual Use

- Four Country Survey Comparing Wave 7 and Wave 8
  - 85% (n=146) of current ENDS users stated that they used ENDS as a tool to help them quit smoking, although only 11% of current ENDS users report having quit since Wave 7.
  - Quitting did not differ between users and non-users of e-cigarettes.
  - After a year of using e-cigarettes as a cessation devise, the vast majority, 89%, had not quit and were still using regular cigarettes.
    (Atkison, et al., 2013).
E-Cigs and Cessation: The Promise vs. The Reality: Dual Use

- A 6-state Quitline survey collected data on 2758 treatment seekers at baseline and then again a 7 months. The authors found that:
  - E-cigarette user groups were significantly less likely to be tobacco abstinent at the 7-month survey compared with participants who had never tried e-cigarettes.
  - The bottom line is that e-cigarette users, while using these products to quit, were not any more likely to have been successful if that had used them at all.
  
    — (Vickermann, et al., 2013)
In a study of 23,521 men and 19,201 women, aged 35–49 years, screened for cardiovascular disease risk factors in the mid 1970s and followed throughout 2002.

“Smoking 1–4 cigarettes per day was associated with a significantly higher risk of dying from ischaemic heart disease and from all causes, and from lung cancer in women” (Bjartveit and Tverdal, 2005).
FDA Deeming Regulations: A Cautionary Tale

- TV, Radio and Social Media Advertising Remain
- Candy Flavoring, including Menthol Remain
- Internet and Mail Order Sales Continue with No Age Restrictions
- WSJ, Wells Fargo, the tobacco industry and E-Cigarette Manufacturers Like the Regulations (or lack thereof)
FDA Deeming Regulations: A Cautionary Tale

- “We Need More Time”; 75-Day Comment Period not Sufficient for tobacco industry
- No Child-Proofing Requirements
- No Warning Labels
- A Minimum of 2 years to Enact, by then the E-Cigarette horse will be even further out of the Barn, Down the Road and Coming to a Clinic, Office and or Home Near You.
Resources

- [http://www.trdrp.org/ecigarettes.php](http://www.trdrp.org/ecigarettes.php)
  - Recorded Live Webcast
  - Copy of Presenter Slides
  - Article: E-cigarettes: The Vapor This Time?
  - CME Credits available

- [http://tobaccocontrol.bmj.com/content/23/suppl_2](http://tobaccocontrol.bmj.com/content/23/suppl_2)
Thank You!

TRDRP
Research for a Healthier California

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