Dual Use: If Electronic Cigarettes are so good, why are there so few exclusive users? 

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“If people have difficulty overcoming both nicotine dependence and long-term habit change, then surely the solution is to help them avoid most of the health risks with only a minimal alteration in their nicotine-seeking habits. This implies a nicotine replacement device which looks like a cigarette and delivers cigarette-like boli of nicotine, but does not deliver the tar and carbon monoxide which cause the vast majority of smoking-related disease..... the development and promotion of such a product (and its eventual replacement of tobacco) could have massive beneficial public health implications lasting into the 21st century.” (Foulds, 1994)

“There is a fine line between being visionary and being wrong.

Unfortunately you have to be a visionary to see it.”

Dr Sheldon Cooper
The Big Bang Theory
Prevalence of electronic cigarette use: smokers and recent ex-smokers (Eng)

Use of e-cigarettes in smokers and recent ex-smokers is growing slowly

N=24611 adults who smoke or who stopped in the past year; increase p<0.001
Proportion of e-cigarette and NRT users who are smokers, Eng

The majority of both e-cigarette and NRT users are ‘dual users’ (also smoke)

N=3601 e-cigarette users and N=1831 NRT users of adults
Proportion of daily e-cigarette and NRT users who are smokers (Eng)

A smaller proportion of both e-cigarette and NRT daily users are ‘dual users’ (also smoke)

N=2037 e-cigarette users and N=744 NRT users of adults
E-cigs not as “sticky” as cigarettes

• In USA, in the PATH wave 1 (2014) data-set (Kasza et al, 2017), almost a quarter (23.8%) of adults who have ever tried a cigarette are currently daily cigarette smokers, but less than 7% (6.8%) of ever e-cig users are daily e-cig users.

• In USA, in the PATH wave 1 (2014) data-set (Kasza et al, 2017), of those (4431) who have used an e-cig in the past 30 days, only 12.7% have NOT used another tobacco product in the past 30 days. i.e. 87% of current e-cig users are dual users with another tobacco product, mainly cigarettes.

• Compare that to past month cigarette smokers (at least one cigarette, n=14,219). 51.5% have not used another tobacco product in the past 30 days. (i.e. 48.5% are dual users)
E-cigs not as “sticky” as cigarettes

- So it seems as though e-cigs are not as “sticky” as cigarettes. People who try e-cigs are less likely to keep using them and certainly less likely to keep using them exclusively, as compared with cigarettes. This is a problem as it means we continue to have many more smokers than e-cig users and the positive effect of cannibalizing the cigarette market is less than we might hope for.
Original investigation

**Development of a Questionnaire for Assessing Dependence on Electronic Cigarettes Among a Large Sample of Ex-Smoking E-cigarette Users**

Jonathan Foulds PhD¹, Susan Veldheer MS¹, Jessica Yingst MS¹, Shari Hrabovsky MSN¹, Stephen J. Wilson PhD², Travis T. Nichols MS ², Thomas Eissenberg PhD³

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### Penn State Nicotine Dependence Questions (% yes)

<table>
<thead>
<tr>
<th>Question</th>
<th>Electronic Cigarette Use (n=3609)</th>
<th>Traditional Cigarette Use (n=3609)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you smoke cigarettes/use e-cigarettes now because it is really hard to quit?</td>
<td>89.4</td>
<td>92.7</td>
</tr>
<tr>
<td>Do you ever have strong cravings to smoke a cigarette/use e-cigarette?</td>
<td>35.4</td>
<td>11.72</td>
</tr>
<tr>
<td>Do you experience strong, very strong, or extremely strong urges to smoke?</td>
<td>85.7</td>
<td>10.5</td>
</tr>
<tr>
<td>Is it hard to keep from smoking a cigarette/use e-cigarette in places where you are not supposed to?</td>
<td>64.5</td>
<td>25.6</td>
</tr>
<tr>
<td>When you haven't smoked cigarettes/used e-cigarettes, do you feel more irritable because you couldn't smoke/use e-cigarette?</td>
<td>26.4</td>
<td>26.4</td>
</tr>
<tr>
<td>When you haven't smoked cigarettes/used e-cigarettes, did you feel more nervous, restless or anxious because you couldn't smoke/use e-cigarette?</td>
<td>41.2</td>
<td>6.8</td>
</tr>
<tr>
<td>Do you sometimes awaken at night to have a cigarette/use e-cigarette?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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¹Penn State University
²Penn State Milton S. Hershey Medical Center
³Penn State College of Medicine
Indicators of Dependence Among Exclusive Daily E-cig Users (n=156) and Exclusive Daily Cigarette Smokers (n=3430) in the PATH Wave 1 Survey*

<table>
<thead>
<tr>
<th>Indicator</th>
<th>E-cig users</th>
<th>Cigarette smokers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty not using where prohibited</td>
<td>5.6</td>
<td>28.6</td>
</tr>
<tr>
<td>Use within 5 minutes of waking</td>
<td>15.1</td>
<td>24.0</td>
</tr>
<tr>
<td>Have strong craving</td>
<td>72.8</td>
<td>86.9</td>
</tr>
<tr>
<td>Really need to use</td>
<td>71.5</td>
<td>88.5</td>
</tr>
<tr>
<td>Consider yourself addicted</td>
<td>77.2</td>
<td>94.0</td>
</tr>
</tbody>
</table>

*All e-cig and cigarette differences p<0.0001 after adjusting for covariates.

There is no such thing as “an e-cig”. There are many different e-cigs.

Examples of electronic cigarette devices currently available on the market (Farsalinos and Polosa, 2014)
There are hundreds of different types of electronic cigarettes. They vary by size, battery power, atomizer resistance, number of coils, liquid nicotine strength, liquid flavor, liquid type (PPG/VG) etc etc. Two broad categories are (a) First Generation/cigalikes (bottom) and Second Generation/Advanced (top)
First generation e-cigs deliver very little nicotine.

Advanced e-cigs deliver a higher blood nicotine concentration typically less than a cigarette.

Some advanced e-cigs can deliver nicotine as rapidly as cigarettes.
Nicotine absorption from a cigarette and different e-cigs in experienced dual users (Hajek et al, 2017)
Plasma nicotine concentration versus time as a function of electronic cigarette (ECIG) nicotine concentration.

Carolina P Ramôa et al. Tob Control 2016;25:e6-e9
Participant transition from first to current device.

Jessica M. Yingst et al. Nicotine Tob Res 2015;17:1242-1246
Fig. 2. Overall weighted scores for each of the products. Cigarettes, with an overall harm score of 99.6, are judged to be most harmful, and followed by small cigars at 67. The heights of the colored portions indicate the part scores on each of the criteria. Product-related mortality, the upper dark red sections, are substantial contributors to those two products, and they also contribute moderately to cigars, pipes, water pipes, and smokeless unrefined. The numbers in the legend show the normalized weights on the criteria. Higher weights mean larger differences that matter between most and least harmful products on each criterion.

Proportion of smokers believing e-cigarettes less harmful than cigarettes

A declining minority of current smokers believe e-cigarettes are less harmful than cigarettes

N=9117 current smokers (in England)
As of 2015, 40% of US adults believe e-cigarettes are about the same harmfulness (36%) or more harmful (4%) than cigarettes. 31% correctly believe e-cigs are less harmful than cigarettes and 30% don’t know. The proportion who incorrectly believe e-cigs are about as or more harmful than cigarettes has increased substantially since 2012 when it was only 13%. (Majeed et al, 2017)

If smokers believe e-cigs are about as harmful, why switch?
• Some say we are already having success with the current policies and smokers are already switching to e-cigs, so let's just keep doing what we are doing.

• Yes, youth and adult cigarette use continues to fall but progress remains very slow.

• Prevalence of daily product use among young adults (age 18-24) in PATH (2013-14) was:
  Cigarettes 14.7%, E-cigs: 1.3%, Smokeless: 2.1%

• Most e-cig use is relatively transient and involves dual rather than exclusive use

• We need strategies to improve on this
To date, the rate at which smokers completely switch to e-cigs has been mildly encouraging but generally disappointing. This is partly because most smokers start with e-cigs with very poor nicotine delivery. This is gradually changing for the better (better nicotine delivery).

Another problem is doubt that e-cigs are really less harmful to health than smoking. This is changing for the worse (public more likely to believe e-cigarettes are about as harmful as cigarettes).
It is important we don’t regulate in a way that limits e-cig nicotine delivery. It is important that we don’t ban flavors that e-cig users like (unless they are shown to have adverse health effects), and it is important that we fully inform the public about our best estimate of the relative health effects of cigarettes and e-cigs.

FDA-mandated reductions of permissible nicotine content in combustible products (e.g. cigarettes) will likely encourage smokers to quit and speed up transition to less harmful nicotine products, like e-cigs.