Electronic Cigarettes: What we know so far

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What I’m going to talk about:

• E-cigarettes: what are they?
• Background: history and regulation
• Who uses them? How? And Why?
• Nicotine content and delivery
• Can they help smokers to stop smoking?
• Are they safe?
• Harm reduction and concerns
Conflict of Interest

I have undertaken research for e-cigarette companies, received products for research purposes and funding for speaking at research conferences.

Thanks to Totally Wicked for sponsoring this lecture.
E-Cigarettes: What are they?
Second Generation E-cigarettes
The Liquid

Contents

- Propylene glycol and/or
- Vegetable glycerine (glycerol)
- Nicotine (in mg/ml; ranging from 0-36)
- Flavourings (e.g. tobacco, mint, fruit)
E-Cigarettes: Background
History

• Introduced into Chinese market in 2004 and Europe in 2006 (Ruyan)

• Rapidly growing market:
  – E-cig use in smokers in UK increased from 2% to 12% in past 2 years (West & Brown, 2013)
  – Estimated 1.3m current e-cig users in the UK (ASH, June 2013)

• Production mainly in China but distributed under various brand names across the world

Tobacco companies now buying into the e-cig market.
Current Regulation

- UK & EU: Consumer product regulated under:
  General Product Safety Directive (GPSD)
- EU & Medicines and Healthcare products Regulatory Agency (MHRA; 2013): announce plans to regulate as medicine
- USA: FDA (2011) plans to regulate e-cigs as a tobacco product
Medicines regulation of E-cigs?

To provide safeguards – in terms of safety, quality and efficacy

But may limit availability and add constraints.

E-cigs ‘dull but safe’

Harder to get hold of than cigarettes

Could encourage illegal devices
Who uses them? How are they used? And why?
Who?
Results from two surveys:

- Mostly male (65-70%)
- Average age: early forties
- Caucasian
- Educated
- Former smokers (80%)
- Current smokers (20%)
- Never smokers (0.03%)

Source: Dawkins et al. (2013); Etter & Bullen (2011)
How?

Average duration: 10 months

<table>
<thead>
<tr>
<th>Product type</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Second generation’</td>
<td>72</td>
</tr>
<tr>
<td>‘Cigarette-like’</td>
<td>18</td>
</tr>
<tr>
<td>‘Custom made’</td>
<td>9</td>
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</table>

<table>
<thead>
<tr>
<th>Strengths used</th>
<th>%</th>
</tr>
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<tbody>
<tr>
<td>18mg/ml</td>
<td>49</td>
</tr>
<tr>
<td>11mg/ml</td>
<td>33</td>
</tr>
<tr>
<td>combine strengths</td>
<td>21</td>
</tr>
<tr>
<td>0 mg/ml only</td>
<td>1</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Preferred flavour</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco</td>
<td>53</td>
</tr>
<tr>
<td>Fruit</td>
<td>33</td>
</tr>
<tr>
<td>Mint/menthol</td>
<td>28</td>
</tr>
</tbody>
</table>

From Dawkins et al. (2013)
And why?

Commonly cited reasons:

– ‘Complete alternative to smoking’
– ‘To quit smoking or avoid relapsing’
– ‘To deal with tobacco craving or withdrawal symptoms’
– ‘Less toxic than tobacco’
– ‘Cheaper than smoking’

Source: Dawkins et al. (2013); Etter & Bullen (2011)
E-cigarettes used in quit attempts

Source: Smoking Toolkit Study
Robert West & Jamie Brown
www.smokinginengland.info
Effects on Tobacco Craving

• E-cig can reduce craving in deprived smokers but not as effectively as tobacco cigarette (Bullen et al., 2010; Vansickel et al., 2010)

• Placebo (0mg/ml) e-cig also associated with decline in craving after 5 mins and...

• Further reduction in craving with nicotine e-cig after 20 mins (Dawkins et al., 2012)
Can they deliver nicotine?
Nicotine Delivery in Naive E-cig Users

• **Study One:**
  – Compared the 0mg, 16mg (Ruyan) e-cig with nicorette inhalator and tobacco smoking
  – E-cig reached max blood level of 1.3ng/ml in 20 mins

• **Study Two:**
  – Compared 2 brands of 16mg e-cigs to tobacco smoking
  – Only tobacco smoking raised blood nicotine levels

• Ineffective / inconsistent vaping in naive users?

Sources: Bullen et al., (2010); Eissenberg (2010)
Nicotine Delivery: Experienced e-cig users using their own devices

Effective nicotine delivery in 8 experienced ‘vapers’

From Vansickle & Eissenberg, (2013)
Nicotine Delivery in regular ‘skycig’ users

Effective nicotine delivery with standard cartomizer device in 14 regular users

From Dawkins & Corcoran (under review)
E-cigs deliver nicotine via inhaled vapour

Used by smokers wanting to quit/replace tobacco smoking

And with increasing popularity

Moderately effective at alleviating tobacco craving...

And can effectively deliver nicotine (at least in habitual users)
Why do we need another nicotine-containing product?
A reminder of the dangers of cigarette smoking

- In England, smoking kills 81,700 people per year
- Multiple other health risks
- Yet 21% continue to smoke
- Tobacco smoke contains > 5000 known chemicals (tar); 40 are known carcinogenics
- Adverse effects due burning process
- Nicotine – relatively safe → NRT
Smoking Cessation

- 67% of smokers want to stop; 75% try to stop
- Only 8% successful at 2 years (ONS Omnibus Survey, 2009)
- Reasons for relapse included:
  - I like smoking (20%)
  - I miss the habit (12%)
- 95-97% of unaided quit attempts end in failure (Hughes et al., 2004)
- NRT doubles a smoker’s chances of quitting successfully (Silagy et al., 2005)
- ...that is, approx. 6-10% successful quitters

Even with NRT > 90% of quit attempts fail.
Why do so many quit attempts end in failure?

- Reluctance to use nicotine medication?
- Ineffective nicotine delivery from NRT?
- Lack of control over nicotine delivery?
- Inability to replace the ‘habit’ of smoking – e.g. Hand-mouth activity?

Plenty of room for further innovation to help smokers to stop
Do E-cigarettes help smokers to stop smoking?
Surveys of E-cigarette users

Study one:
• 74% of respondents had not smoked at all for at least a few weeks since starting to use the e-cig
• 14% dramatically reduced their cigarette consumption
  (Dawkins et al., 2013)

Study two:
• 92%: E-cig helped to reduce my smoking
• 96% (ex-smokers): e-cig helped me to stop smoking
  (Etter & Bullen, 2011)
Effects of E-cigs on smoking behaviour

• Survey of smokers who had purchased an e-cigarette:
  – 31% abstinent from smoking at 6 months
  – Those using e-cig > 20x/day: quit rate 70%

• Study of 40 smokers not willing to quit
  – 6 months smoking abstinence or 50% reduction shown in 55%

Sources: Siegel et al. (2011): Polosa et al. (2011):
Randomised Controlled Trials

- ‘Categoría’ 7.2mg nicotine e-cig vs. 4.8mg nicotine e-cig vs. no nicotine e-cig
  - 300 smokers (unwilling to quit)
  - 1 year abstinence rates: 13%, 9% and 4%

- ‘Elusion’ 16mg nicotine e-cig vs. no nicotine e-cig vs. nicotine patch
  - 657 smokers followed up over
  - 6 months
Are E-cigarettes Safe?
Contents of Fluid:

• Nicotine
  – Lethal dose from 30mg
  – 20ml bottle of 18mg/ml nicotine contains 360mg of nicotine

• Flavours – e.g. Food additives
  – Safe for ingestion but effects of long-term inhalation unknown
• **Propylene glycol**
  – Found in foods, medicines, cosmetics, artificial fog; generally regarded as safe for oral consumption (FDA).
  – Long term effects of inhalation unknown
  – Humectant = dry throat & mouth

• **Glycerine**
  – Possibility of contamination with diethylene glycol.
  – Found in 1/18 samples tested by FDA
Vapour: Cancer-causing substances

<table>
<thead>
<tr>
<th>Toxic Compound</th>
<th>E-cigarette</th>
<th>Cigarette</th>
<th>Ratio Cig vs. E-cig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrosamines (ng)</td>
<td>0.0028</td>
<td>0.19</td>
<td>68</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>5.61</td>
<td>52</td>
<td>9</td>
</tr>
<tr>
<td>Acetaldehyde</td>
<td>1.36</td>
<td>140</td>
<td>450</td>
</tr>
<tr>
<td>Toluene</td>
<td>0.63</td>
<td>70</td>
<td>120</td>
</tr>
</tbody>
</table>

E-cigs vapours contained some toxic substances but 9 to 450 times lower than those in tobacco cigarettes

Source: Goniewicz et al. 2013, BMJ
Vapour: Effects on Indoor Air

PM$_{2.5}$ concentration in indoor air (µg/m$^3$)

E-cig vapour does reduce air quality but to a far lesser extent than cigarette smoke.

From Pellegrino et al. 2012, *Ann Ig*
Switching from cigarettes to e-cigarettes
Harm Reduction

- Best approach – quit nicotine completely
- But many smokers are unwilling or unable to quit
- E-cigs could be a lower risk alternative to tobacco smoke
- Huge increase in number of smokers using e-cigs to quit
- Dramatic potential impact on public health
Some commonly expressed concerns:

1. E-cigs appeal to youngsters and may be a gateway to smoking.
   - 1/5th of Polish youths had tried e-cigs
   - 3.2% of never smoking youths (Goniewicz et al. 2012)

2. E-cigs ‘normalise’ or ‘glamorise’ smoking

3. E-cigs cannot be considered safe
More commonly expressed concerns:

4. People who consider quitting might develop a new nicotine habit instead

5. We don’t know what’s in the liquid and vapour

6. There is potential for nicotine over-dosing or poisoning

7. There is inconsistent labelling of nicotine levels
Summary

E-cigs deliver nicotine via inhaled vapour

Less dangerous than cigarettes

Increasing evidence that smokers are using them to stop smoking

Huge potential for harm reduction i.e. improving public health at national and international level

Overly cautious regulation may not be in the best interest for public health
Thanks to...

- The Drugs and Addictive Behaviours Research Group (DAB RG)
  - Amanda Roberts
  - John Turner
  - Kirstie Soar
- Colleagues at UEL: Olly Knight, Nicola Quilter, Fotios Savva, Gareth Greene
- Assistants: Laura Opaluwa, Muti Orisakiya & Abi Turner
- Totally Wicked

Lecture available at: www.uel.ac.uk/ecigarettelecture
Questions?