Research on electronic cigarettes (ECs) in Poland

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38 mln citizen

24.4% (9.3 mln) smokers

1.3 mln vapers

Two Scientific Centers

Hundred of comments
AGENDA

• Comparision of selected toxicants in tobacco smoke and in vapour from ECs
• Accurately labelled nicotine levels in e-liquid
• Influence of aerosol generated parameters and flavours on carbonyl compounds levels in vapour
• Secondhand exposure from ECs
• Prevalence of ECs use among adolescent in Poland
• Influence of ECs use on cardiovasular risk factors
Levels of selected carcinogens and toxicants in vapour from electronic cigarettes

Maciej Lukasz Goniewicz,1,2,3 Jakub Knysak,3 Michal Gawron,3
Leon Kosmider,3,4 Andrzej Sobczak,3,4 Jolanta Kurek,4 Adam Prokopowicz,4
Magdalena Jablonska-Czapla,5 Czesława Rosik-Dulewska,5 Christopher Havel,6
Peyton III Jacob,6 Neal Benowitz,6

Table 4 Comparison of toxins levels between conventional and electronic cigarettes

<table>
<thead>
<tr>
<th>Toxic compound</th>
<th>Conventional cigarette (µg in mainstream smoke)35</th>
<th>Electronic cigarette (µg per 15 puffs)</th>
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NNK, N'-nitrosonornicotine (NNN) and 4-(methyleneamino)-1-(3-pyridyl)-1-butanone; NNN, N'-nitrosonornicotine.

Cadmium: 0.0138–0.0624 0.0000001–0.000022 3300
Lead: 0.0071–0.0289 0.0000003–0.000057 600
1. Does e-cigarette deliver nicotine effectively?

2. What parameters influence on the nicotine delivery?

3. Is the manufacturer’s description of nicotine concentration reliable?
Does EC deliver nicotine effectively?

• Most of the analyzed ECs effectively delivered nicotine during the first 150–180 puffs.
• On an average, 50% – 60% of nicotine from a cartridge was vaporized.
1. ECs generate vapor that contains nicotine, but ECs brands and models differ in their efficiency and consistency of nicotine vaporization.

2. In ECs, which vaporize nicotine effectively, the amount inhaled from 15 puffs is lower in comparison with smoking a conventional cigarette.
What parameters influence on the nicotine delivery?

Battery voltage 3.2 V

nicotine [mg]/150 puffs

- VG
- VG/PG
- PG

liquid type

KOSMIDER L, SOBCZAK A, 2014 SRNT 20TH ANNUAL MEETING February 5-8, 2014, Seattle
What parameters influence on the nicotine delivery?

KOSMIDER L, SOBCZAK A, 2014 SRNT 20TH ANNUAL MEETING FEBRUARY 5-8, 2014, SEATTLE
Is the manufacturer’s description of nicotine concentration reliable?

**Original Investigation**

**Nicotine Levels in Electronic Cigarettes**

Maciej L. Goniewicz, Ph.D.,1,2 Tomasz Kuma, M.Pharm.,1 Michal Gawron, M.Pharm.,1 Jakub Knyazek, M.Pharm.,1 & Leon Kosmider, M.Pharm.,1

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**Year 2012**

Relative difference in concentration [%]

- 89% ÷ 28%

AEMSA (American e-Liquid Manufacturing Standards Association)

±10%

19/35

54 %

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**Year 2014**

Relative difference in concentration [%]

- 38% ÷ 9%

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Research paper

Nicotine levels in electronic cigarette refill solutions: A comparative analysis of products from the US, Korea, and Poland

Maciej L. Goniewicz1,2, Ribhu Gupta3, Yong Hee Lee3, Skyler Reinhardt1, Sungroul Kijm4, Bokyong Kim4, Leon Kosmider4,5, Andrzej Sobczak6
Comparison selected toxicants in tobacco smoke and in vapour from EC

Levels of selected carcinogens and toxicants in vapour from electronic cigarettes

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NNK, N'-nitrosonornicotine (NNN) and 4-(methylnitrosoamino)-1-(3-pyridyl)-1-butanol; NNN, N'-nitrosonornicotine.
Carbonyl compounds in EC vapors

1. Both solvent and battery output voltage significantly affect levels of carbonyl compounds in EC vapors.

2. Increasing voltage from 3.2 to 4.8 V resulted in 4 to over 200 times increase in formaldehyde, acetaldehyde, and acetone levels.

3. The health risk will still probably be lower in comparison with smoking.

↑voltage → ↑power → ↑heat (temperature)
Carbonyl compounds in EC vapors

Cherry-flavoured electronic cigarettes expose users to the inhalation irritant, benzaldehyde
Kosmider L, Sobczak A, Prokopowicz A, Kurek J, Zaciera M, Knysak J, Smith D, Goniewicz ML.

1. Benzaldehyde was detected in 108 out of 145 examined products
2. The highest yields of benzaldehyde were observed in cherry-flavoured products 5.1-141 µg/30 puffs
3. Non-cherry-flavoured products were within range 0.03-10.3 µg/30 puffs
4. The benzaldehyde doses inhaled were often higher than doses inhaled from cigarette

However
The estimated median daily inhaled dose from cherry-flavoured EC would be 100 time lower than PEL dose in the workplace
Secondhand exposure

From tobacco smoke

+ side stream smoke > exhaled smoke

From EC vapor

> exhaled vapor
Five volunteers (all male; nicotine dependence by FTND 5.8 ± 2.9), who were dual users. (vaping and smoking in exposure chambers)

- The average concentration of nicotine resulting from smoking tobacco cigarettes was 10 times higher than from e-cigarettes.
- The mean concentration of PM2.5 resulting from smoking tobacco cigarettes was 7 times higher than from e-cigarettes.
- In contrast to cigarette smoking, no carbon monoxide, and volatile organic compounds in an exposure chamber after used of e-cigarettes were found.
Rise in Electronic Cigarette Use Among Adolescents in Poland
Goniewicz ML, Gawron M, Nadolska J, Balwicki L, Sobczak A

The current use of e-cigarettes among adolescents in Poland was significantly higher in the 2013-2014 sample than the 2010-2011 sample (29.9% vs. 5.5%, respectively; p < .05).

Limitation
Students were asked both whether they had ever and currently (in the past 30 days) smoked tobacco cigarettes or puffed on e-cigarettes (even a single puff).
A cross-sectional survey of a sample of 1785 Polish students aged 16-18

- 21.8% of students were dual users.
- Dual users were more likely to smoke tobacco cigarettes on a daily basis [AOR 3.54 (95% CI 2.34–5.36)]
- And less likely to smoke fewer cigarettes per day [AOR 0.27 (95% CI 0.12–0.57)] than exclusive tobacco cigarette users.
Crucial conclusion

1. ECs are much safer than conventional cigarettes if we take into account toxicant levels in tobacco smoke and vapor

2. Using an e-cigarette in indoor environments may expose nonusers to low dose of nicotine but not to the tobacco-specific combustion products. Therefore secondhand exposure from EC is much more lower than from conventional cigarette.

3. Possible increase of ECs prevalence among adolescent
Influence ECs use on cardiovascular risk factors
(ongoing research)

- Groups of 163 healthy female/male volunteers
  - nonsmokers (n=51; 37,1±5,3 years)
  - e-users (n=48; 30,1±5,8 years) – at least 6 months
  - smokers (n=35; 31,3±5,7 years) – at least 2 years
  - dual users (n=29, 26,8±5,8 years) – at least 6 months and 2 years

- Classical risk factors (cholesterol, HDL, LDL, TG)

- Non-classical risk factors (fibrynogen, hsCRP, homocysteine)

- Emerging risk factor (ADMA, homoarginine)

- Heavy metals lead and cadmium
Influence ECs use on cardiovascular risk factors (part of the crude results)
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(part of the crude results)
Thank you for your attention