Poison center experience with cases involving e-cigarettes

Lies Scholtens, Dutch Poisons Information Center
Poison center experience with cases involving e-cigarettes

Content

• Introduction
• Studies about reported e-cigarette exposures to poison centres.
• E-cigarette exposures reported to the Dutch Poisons Information Center
• Practical implications of these data.
• Conclusions
Introduction

Tasks of poison centers:
  Providing information on poisoning

Surveillance of emerging exposures and trends
Introduction

- Increase of the use of e-cigarettes
- Increase of availability in households
- Increase of accidental and intentional exposures to e-liquids
  - nicotine intoxication
  - Increasing calls to poison centers
**Introduction**

Since 2007 – 2009 e-cigarettes came onto the market

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**Graph:**

- **2009** - **2013**
  - Ordonez et al --Texas Poison enters
  - Davanzo et al --NPCC Milan

**Dutch Poisons Information Center**

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**Graph:**

- **2008 - 2015**
  - U.S. Poison Centers  Vakkalanka J.P. et al

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**Figure 1:** Monthly exposures reported to U.S. Poison Centers.
Reported e-cigarette exposures to poison centres

Selected publications

1. “Epidemiological trends in electronic cigarette exposures reported to U.S. Poison Centers”
   Vakkalanka J.P. et al, Clinical Toxicology 2014 (n=1700)
2. “Electronic cigarette exposures reported to Texas Poison Centers”
   Ordonez J.E. et al, Nicotine & Tobacco Research 2015 (n=225)
3. “Surveillance of hazardous exposures to electronic cigarettes in Italy” (abstract)
   Davanzo F et al, Clinical Toxicology 2014 (n=185)
   Thomas E et al, Clinical Toxicology 2014 (n=150)
Reported e-cigarette exposures to poison centres

Who are exposed?

Age

Gender

Exposure route

1. Vakkalanka J.P. et al (n=1700)  US
2. Ordonez J.E. et al (n=225)  Texas
3. Davanzo F et al (n=185)  Italy
4. Thomas E et al (n=150)  UK
## Reported e-cigarette exposures to poison centres

### Exposure reasons

<table>
<thead>
<tr>
<th>References</th>
<th>1 n=1700</th>
<th>2 n=225</th>
<th>3 n=185</th>
<th>4 n=150</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Accidental</td>
<td>80</td>
<td>87</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>Intentional</td>
<td>7,5</td>
<td>5</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Adverse reaction</td>
<td>11,5</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

1. Vakkalanka J.P. et al (n=1700)  US
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<tr>
<th>Medical outcome</th>
<th>1 n=1700</th>
<th>2 n=225</th>
<th>3 n=185</th>
<th>4 n=150</th>
</tr>
</thead>
<tbody>
<tr>
<td>No effects</td>
<td>20,8 %</td>
<td>24 %</td>
<td>62 %</td>
<td>90,5 %</td>
</tr>
<tr>
<td>Minor effects</td>
<td>25,6 %</td>
<td>19 %</td>
<td>36,9 %</td>
<td>8,2 %</td>
</tr>
<tr>
<td>Moderate effects</td>
<td>4,5 %</td>
<td>4 %</td>
<td>1,1 %</td>
<td>1,3 %</td>
</tr>
<tr>
<td>Major effects</td>
<td>0,2 %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td>0,06 *</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not followed-non toxic</td>
<td>3,7 %</td>
<td>6 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not followed- minimal effects possible</td>
<td>33,9 %</td>
<td>35 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unable to follow-potentially toxic</td>
<td>5,4 %</td>
<td>9 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unrelated effects</td>
<td>5,7 %</td>
<td>3 %</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* n=1

1. Vakkalanka J.P. et al (n=1700) US
2. Ordonez J.E. et al (n=225) Texas
3. Davanzo F et al (n=185) Italy
4. Thomas E et al (n=150) UK
# Reported e-cigarette exposures to poison centres

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<td>1,1</td>
<td>1,3</td>
</tr>
<tr>
<td>Major effects</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
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<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unable to follow - potentially toxic</td>
<td>5,4</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unrelated effects</td>
<td>5,7</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Moderate effects:**

*39 years old male*
- intentional ingestion of an unknown amount of e-liquid
- vomiting, confusion, bradypnea, hypertension, tachycardia and atrial fibrillation

**Death:**

*29 years old male:*
- injected the refilling e-liquid intravenously
- nicotine toxicity, seizures and cardiopulmonary arrest

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1. Vakkalanka J.P. et al (n=1700) US
2. Ordonez J.E. et al (n=225) Texas
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### Reported e-cigarette exposures to poison centres

#### Clinical Symptoms

<table>
<thead>
<tr>
<th>Symptom</th>
<th>1 (n=1700)</th>
<th>2 (n=225)</th>
<th>3 (n=185)</th>
<th>4 (n=150)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral irritation</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Nausea</td>
<td>13</td>
<td>10</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Vomiting</td>
<td>16</td>
<td>20</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>2,5</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Diaphoresis</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agitated/irritable</td>
<td>4</td>
<td></td>
<td></td>
<td>reported</td>
</tr>
<tr>
<td>Headache</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dizziness</td>
<td>5,5</td>
<td>5</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>4,5</td>
<td></td>
<td></td>
<td>reported</td>
</tr>
<tr>
<td>Ocular irritation</td>
<td>3,5</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

#### Also reported <3%

<table>
<thead>
<tr>
<th>Symptom</th>
<th>ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lethargy</td>
<td>1,2</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>1</td>
</tr>
<tr>
<td>Tremor</td>
<td>1,4</td>
</tr>
<tr>
<td>Chest pain</td>
<td>1,4</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>1,4</td>
</tr>
<tr>
<td>Pallor</td>
<td>1</td>
</tr>
<tr>
<td>Anxiety</td>
<td>4</td>
</tr>
<tr>
<td>Dermal irritation</td>
<td>1</td>
</tr>
</tbody>
</table>
Dutch Poisons Information Center

Telephone 44.000 / year

440 tobacco/ nicotine product exposures ~10% e-cigarette exposures

Website: 51.000 / year
E-cigarette exposures reported to the DPIC

January 2013 – May 2016: 133 reported exposures

**Age (%)**

- >18 years: 70%
- 4-18 years: 6%
- 0-4 years: 24%
- Unknown: 6%

**Gender (%)**

- Female: 63%
- Male: 34%
- Unknown: 3%

**Exposure route**

- Ingestion: 81%
- Inhalation: 7%
- Skin contact: 5%
- Eye contact: 8%

119 individuals
E-cigarette exposures reported to the DPIC

1. What were exposure reasons?

2. Did these exposures cause (severe) health effects?

3. When is hospital observation needed?
E-cigarette exposures reported to the DPIC

January 2013 – May 2016: 133 reported exposures

Exposure reasons

<table>
<thead>
<tr>
<th>Age</th>
<th>Intentional N (%)</th>
<th>Accidental N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 18 years</td>
<td>3 (2%)</td>
<td>34 (26%)</td>
</tr>
<tr>
<td>&gt; 18 years</td>
<td>47 (35%)</td>
<td>49 (37%)</td>
</tr>
</tbody>
</table>

- Intentional exposures
- Accidental exposures:
  1. product related
  2. improper use
  3. children and adolescents (<18 yr)
Exposure reasons

Age > 18 years

Intentional exposure:

**Ingestion:** n=40

Information requests by health care professionals of:
- Psychiatric hospitals: 25
- Emergency Room: 9
- General practitioner: 6

**Inhalation:**

Excessive use of the e-cigarette: **Age: >18 years**, n=7
Excessive use of the shisha pen: **Age: 10 – 13 years**, n=3
Exposure reasons

Age > 18 years

Accidental exposures: N = 49

1. Product related exposures: N = 22

<table>
<thead>
<tr>
<th>Exposure reasons</th>
<th>N</th>
<th>Exposure route</th>
</tr>
</thead>
<tbody>
<tr>
<td>leaking e-liquid (during normal use of the e-cigarette)</td>
<td>21</td>
<td>Ingestion (20) dermal (face) (1)</td>
</tr>
<tr>
<td>explosion of (the battery) of the e-cigarette</td>
<td>1</td>
<td>dermal (hand)</td>
</tr>
</tbody>
</table>
## Exposure reasons

### Age > 18 years

Accidental exposures: $N = 49$

2. Exposures by improper use of e-liquid: $N = 27$

<table>
<thead>
<tr>
<th>Exposure reasons</th>
<th>N</th>
<th>Exposure route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingestion of e-liquid which was poured in a glass</td>
<td>10</td>
<td>Ingestion</td>
</tr>
<tr>
<td>Licking of spilled e-liquid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pouring e-liquid in someone’s coffee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dripping e-liquid on the tongue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of the e-cigarette without mouthpiece</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spilling of e-liquid when filling the e-cigarette</td>
<td>2</td>
<td>Dermal (hand)</td>
</tr>
<tr>
<td>E-liquid mistaken for eye drops: e-liquid was accidentally dripped in the eyes</td>
<td>1</td>
<td>Ocular</td>
</tr>
<tr>
<td>Unknown</td>
<td>14</td>
<td>Ingestion(7) Ocular (5) Dermal (2)</td>
</tr>
</tbody>
</table>
### Exposure reasons

**Age < 18 years old**

Accidental exposures $N = 34$

<table>
<thead>
<tr>
<th>Exposure reasons</th>
<th>N</th>
<th>Age yr</th>
<th>Exposure route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to refill bottle</td>
<td>27</td>
<td>0-4</td>
<td>ingestion</td>
</tr>
<tr>
<td>Access to refill bottle</td>
<td>2</td>
<td>0-4</td>
<td>dermal</td>
</tr>
<tr>
<td>Put a clearomizer in his mouth</td>
<td>1</td>
<td>8</td>
<td>ingestion</td>
</tr>
<tr>
<td>e-liquid mistaken for cough syrup</td>
<td>1</td>
<td>2</td>
<td>ingestion</td>
</tr>
<tr>
<td>Leaking of e-liquid during vaping</td>
<td>2</td>
<td>16</td>
<td>ingestion</td>
</tr>
<tr>
<td>While filling the e-cigarette</td>
<td>1</td>
<td>16</td>
<td>dermal</td>
</tr>
</tbody>
</table>
1. What were exposure reasons?

2. Did these exposures cause (severe) health effects?

3. When is hospital observation needed?
Exposure reasons versus clinical symptoms

All exposure routes

- Number
- abdominal pain
- dizziness
- nausea
- vomiting
- oral irritation
- no symptoms

- Intentional n=50
- by leakage n=22
- by improper use n=27
- children <18 years n=34

34%
Exposure reasons versus clinical symptoms

- **Number**
  - All exposure routes
  - Total: 50
  - Intentional: 50
  - By leakage: 22
  - By improper use: 27
  - Children <18 years: 34

- **Clinical Symptoms**
  - Chest pain: 2
  - Palpitations: 2
  - Sinus arrhythmia: 1
  - Tachycardia: 3
  - Bradycardia: 3
  - Hypertension: 3
  - Hypotension: 1

- **Bar Chart**
  - Number of occurrences for each symptom by exposure reason.
Exposure reasons versus clinical symptoms

- **Unknown**
- **Headache**
- **Pallor**
- **Irritable**
- **Drowsiness**
- **Lethargy**
- **Confusion**
- **Tremors**
- **Skin irritation**
- **Ocular irritation**
- **Hyperventilation**
- **Flushing**
- **Sweating**

**Intentional** n=50
- by leakage n=22
- by improper use n=27
- children <18 years n=34

**Number**
Case of a psychiatric patient

12 times intentional ingestion of e-liquid in 2015

<table>
<thead>
<tr>
<th>Date</th>
<th>Nicotine mg/kg</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-02</td>
<td>0,5</td>
<td>No</td>
</tr>
<tr>
<td>06-03</td>
<td>1,4</td>
<td>Dizziness</td>
</tr>
<tr>
<td>17-03</td>
<td>0,7</td>
<td>No</td>
</tr>
<tr>
<td>18-03</td>
<td>2,0</td>
<td>Palpitation, Tachycardia, Hypotension, Tremors</td>
</tr>
<tr>
<td>06-04</td>
<td>2,0</td>
<td>Abdominal pain, Dizziness, Headache</td>
</tr>
<tr>
<td>18-05</td>
<td>1,3</td>
<td>Not reported</td>
</tr>
<tr>
<td>20-05</td>
<td>1,5</td>
<td>Nausea, Chest pain, Tachycardia (124 bpm)</td>
</tr>
<tr>
<td>13-06</td>
<td>2,9</td>
<td>No</td>
</tr>
<tr>
<td>27-07</td>
<td>1,0</td>
<td>Chest pain</td>
</tr>
<tr>
<td>13-09</td>
<td>1,4</td>
<td>No</td>
</tr>
<tr>
<td>29-10</td>
<td>2,9</td>
<td>Dizziness</td>
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<tr>
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Nicotine Dose – effect relationship

Nicotine toxicity

• Lethal dose 40-60 mg.
  Rudolf Kobert (1854 -1918): “Lehrbuch der intoxikationen” 1908

• Lethal dose: 0,5-1 gram
  Tracing back the generally accepted lethal dose to dubious self-experiments in the nineteenth century.
Nicotine dose – effect relationship

- Information supply of the DPIC is based on the dose – effect relationship
- Estimating of the amount of ingested nicotine mg/kg which can lead to a mild, moderate or severe intoxication

DPIC: moderate/ severe nicotine intoxication:

Change: from > 1.0 mg/kg bodyweight to > 1.5 mg/kg bodyweight
## Nicotine Dose – effect relationship

### Hospital observation:

<table>
<thead>
<tr>
<th>Year</th>
<th>&lt; 18 years</th>
<th>&gt; 18 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013 (n= 33)</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>2014 (n = 44)</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>2015 (n= 32)</td>
<td>2</td>
<td>13</td>
</tr>
</tbody>
</table>
E-cigarette exposures report

Reporting to:
The Netherlands Food and Consumer Product Safety Authority (annual report)

Adjustment of the Dutch legislation?

- Maximum nicotine concentration in refills: 20 mg/mL
- Maximum volume of refill bottles: 10 mL
- Maximum volume of refillable reservoirs/cartridge: 2 mL
- The labelling and packaging should display sufficient and appropriate information on their safe use.
- Products are child- and tamperproof, including child-proof labelling, fastenings and opening mechanisms.

Intended for implementation in national legislation in 2016
Legislation

The Dutch State Secretary:

Temporary e-cigarette (Commodities act) decree in 2015

- Increasing use of the e-cigarette
- Investigation by the National Institute for Public Health and the environment
- The DPIC annual reports to The Netherlands Food and Consumer Product Safety Authority

Reference:

1. E-cigarette factsheet
   http://www.rivm.nl/Onderwerpen/T/Tabak/Nieuwe_producten/Esigaret
2. Meldingen over e-sigaret navulvloeistoffen aan het NVIC in 2013 en 2014
   http://www.umcutrecht.nl/nl/Subsites/Nationaal-Vergiftigingen-Informatie-Centrum-(NVIC)/Acute-vergiftigingen
Conclusions

• Most e-cigarette exposures reported to poison centers did not cause severe nicotine intoxications.

• Nevertheless, nicotine is a toxic compound and e-liquids with high nicotine concentrations are easily available for intentional ingestions.

• In order to limit accidental exposures (e-liquid leaking) the product e-cigarette must be safe(r).

• Poison centers can contribute to safe(r) products on the market by reporting e-cigarette exposures to the food and consumer organizations. Therefore, maintaining good relationships between PC’s and governments by long-term investments is important.
Questions

Thank you for your attention