Investigating and diagnosing patients who have been exposed to cabin fume events

Nina Glaser
Federal Institute for Risk Assessment (BfR)

Working Fields /Departments

- Foods
- Chemicals
- Cosmetics
- Commodities
- Pesticides
- Zoonosis

Poisoning and Product Documentation
Para. 1
Manufacturers/ Distributors/ Importers of hazardous mixtures are required to inform BfR of trade name, details on composition, details on use, labelling, first aid and emergency measures.

Para. 2
Any physician appointed for the treatment or assessment of consequences of an illness suspected of being ascribable to the effects of hazardous substances must inform the BfR with the appropriate data (age/sex of patient, cause of exposure, amount, symptoms established).

For occupational accidents: empowerment of statutory accident insurance institution to notify these cases.

Para. 3
Poison Control Centres shall report to the BfR findings of general interest resulting from their activities in relation to poisoning-related illnesses.
Köln/Bonn: Germanwings soll Beinahe-Crash vertuscht haben


2009: 1
2010: 1
2012: 7
2013: 296
2014: 380
2015: ~ 450 (?)

685 cases
December 2010: Airbus 319 during decent into Cologne
Co-pilot and pilot noticed an “electric” and sweet smell
Both felt physical and cognitive impairment, nausea, paraesthesia and tunnel vision
Donning of oxygen mask: pilot felt better; co-pilot’s condition worsened
Pilot managed to land despite severe impairment; the co-pilot felt almost completely incapable to assist
No report of smell or problems from the cabin
Both pilots were examined at a nearby hospital and discharged after 2 h

Mass media “dramatic blood values”:
- oxygen saturation under 80% as remembered by the pilots, written report: 99%
- Co-pilot: Creatine Kinase extremely high (26,804 U/l) – but due to excessive athletic sports
Pilot was on duty 4 days later, co-pilot was for 5 weeks on sick leave and suffered then from posttraumatic stress disorder
Subsequent check-up by airline’s technicians: smell confirmed, described as most likely originating from de-icing fluid

Cases included & excluded

Included:

- All cases notified by physicians regarding patients who reported exposure to a “fume” in a plane and perception of...
  - an abnormal smell or
  - any sign and symptoms
  ...by the patient (or somebody else in the plane)
- And all cases reported by the statutory accident insurance institution under the category “fume event”

Excluded: due to location or source (no fume): 16 cases

- 8 cases: ammonia gas from the battery used to operate the gangway
- 2 cases: symptoms after transportation of alkaloids in cargo
- 3 cases: spraying of unknown substance (poss. insecticides)
- 1 case: overheated laptop at the airport
- 1 case: inhalation of fuel vapour outside the plane
- 1 case: ruptured blood vessel in eye due to air pressure conditions

669 cases
Out of 669 cases…

Gender:
- Female: 402
- Male: 228
- Unknown: 39

Profession:
- Flight attendants: 406
- Pilots: 121
- Unknown: 140 (but professional)
- Other: 2 (1 x ramp agent, 1x daughter of pilot)
- No passengers!

Monthly distribution:
Smell perception

Smell:
- Yes: 511
- No: 27
- Unknown: 131

Description of smell
- Oil: 82
- Dirty socks, musty,…: 69
- Charred: 48
- Chemical: 29
- Sweetish: 25
- Exhaust fumes, smoke: 17
- „Electric“: 8
- ….

Most of events: very similar description of smell by all patients, often identical wording

13 events (19 patients) report smoke/steam/fog
## Symptoms

<table>
<thead>
<tr>
<th>Organ</th>
<th>Most frequently reported symptoms:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smell, taste (78%)</td>
<td>Unpleasant smell (76%), unpleasant taste (3%)</td>
</tr>
<tr>
<td>CNS/PNS (49%)</td>
<td>Headache (34%), dizziness (22%), tingling sensations (8 %), drowsiness (6%), difficulties in concentrating (5%), numbness (3 %), ataxia (2%), tremor (2%)</td>
</tr>
<tr>
<td>Respiratory system (26%)</td>
<td>Respiratory tract irritation (17%), breathing difficulty (4%), chest pain (4%), cough (3%), dyspnoea (2%)</td>
</tr>
<tr>
<td>Gastrointestinal system (26%)</td>
<td>Nausea (20%), dry mouth (4%), tongue disorder (2%), sore throat (2%)</td>
</tr>
<tr>
<td>Eye (12%)</td>
<td>Ocular irritation (8%), sight disorder (4%)</td>
</tr>
<tr>
<td>General (9%)</td>
<td>Weakness (9%)</td>
</tr>
<tr>
<td>Red blood cells (9%)</td>
<td>CO-Hb increased (8%), Met-Hb (4%)</td>
</tr>
<tr>
<td>Skin (4%)</td>
<td>Erythema (2%), irritation of skin (1%)</td>
</tr>
<tr>
<td>Cardiovascular system (3%)</td>
<td>Palpitation (1%), circulatory dysregulation (1%)</td>
</tr>
</tbody>
</table>

### Neurological examination:
- In 205 cases a neurological examination was performed
- 5 patients showed abnormalities in neurological examination:
  - 3x disturbance of sharp/blunt discrimination
  - 2 x reduced reflexes
  - 2 x ataxia
  - 1x pallesthesia
  - 1x hyperesthesia of tongue
Symptoms

Sometimes cluster of patients with similar symptoms - e.g. case X: 8 patients, oil smell:
- Headache: 6
- Sore throat: 5
- reddening of the throat: 3
- (+ other symptoms reported: 1-2 x each)

But generally very different symptoms: e.g. case Y:

<table>
<thead>
<tr>
<th>Patient</th>
<th>No symptoms</th>
<th>CNS</th>
<th>PNS</th>
<th>Respiratory system</th>
<th>Eye</th>
<th>Cardiovascular-system</th>
<th>Gastrointestinal system</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (Stewardess)</td>
<td></td>
<td>disturbances of consciousness, sight disorder</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B (Pilot)</td>
<td>no symptoms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C (Pilot)</td>
<td></td>
<td>dizziness, paresthesia</td>
<td>chest pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D (Stewardess)</td>
<td></td>
<td>dizziness</td>
<td>chest pain</td>
<td></td>
<td>flickering in eyes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E (Stewardess)</td>
<td></td>
<td></td>
<td></td>
<td>burning of eyes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F (Stewardess)</td>
<td></td>
<td>dizziness, sight disorder</td>
<td>paresthesia</td>
<td>reddening of throat</td>
<td>tachycardia</td>
<td>nausea</td>
<td></td>
</tr>
</tbody>
</table>
Severity and treatment

Poison Severity Score:

- None: 26%
- Minor: 63 %
- Moderate: 3%
- Severe: 0%
- Not able to determine: 8%

21 moderate cases:

- 8 cases: severe/long-lasting headache
- 4 cases: circulatory collapse/severe circulatory problems
- 2 cases: severe vomiting
- 1 case each: severe disturbances of consciousness, severe cough, cardiac arrhythmia, severe sore throat, long-lasting and severe muscle pain

Treatment:

- Ambulant: 92%
- In-patient: 3%
- Unknown: 5%
Blood analysis

Blood gas analysis

- **O₂**: low saturation (< 95%): 1/67 cases (91%)
- **CO**: increased values (> 2% Co-Hb for non-smokers/unknown smoker-status)
  - 54/155 (exclusion of results from one lab: 29/128)
  - Maximal value measured: 10% CO-Hb
    (exclusion of results from one lab: 7.3% (non-smoker!))
  - For the majority no information on smoker-status
- **Met-Hb**: increased values (> 2% Met-Hb)
  - 28/114 (exclusion of results from one lab: 4/87)
  - Maximal measured value: 12.2% Met-Hb
    (exclusion of results from one lab: 2.5%)
- **CO₂**: one case decreased, hyperventilation hypothesised (drowsiness, headache, tingling sensation)

Cholinesterase:

- 4/61 cases decreased
Causes discussed

• **Tricresyl phosphate (TCP)**  
  Disappearing from discussion??? 2013: 22.0 % suspected in doctors report, 2014: 3.7 %

• **Organophosphorus compounds (e.g. in flame retardants)**

• **Carbon monoxide (CO)**

• **Lack of oxygen**

• **Hyperventilation/hypocapnia**

• **Ozone**

• **Deicing fluid**

• **Volatile organic compounds (VOCs), aldehydes, organic acids (→ smell)**

• **Smell: food, burnt particles in stove, perspiration, …**

• **General working conditions:**
  dry air, changing pressure, long working shifts, night shifts, jetlag
Involvement of BfR in current national activities

• Contribution to branch conference: “Air quality in commercial aircraft”, spring 2014, organised by German statutory accident insurance institution for transport industry
• “Fume and smell events in focus for cabin air quality – Fact-finding Workshop”, organised by German Aerospace Center (DLR), Summer 2016
• Cooperation in an approach of German Aviation Association (BDL) to improve standardised notification procedure for fume events
• Cooperation with Institute for Occupational and Social Medicine, University of Göttingen, Germany

… and ongoing case analysis (450 cases for 2015 !)
Thank you for your attention

Nina Glaser

Federal Institute for Risk Assessment
Max-Dohrn-Str. 8-10  10589 Berlin
Phone +49 30 - 184 12 - 0  Fax +49 30 - 184 12 - 47 41
bfr@bfr.bund.de  www.bfr.bund.de