Combustion Particles and Preventive Measures against Cancer
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Prof. Thomas Cerny M.D.
Head Oncology / Hematology Dept. St.Gallen
President Swiss Cancer League
thomas.cerny@kssg.ch
What to do?
Tabacco Use in the USA

Figure 1A. Tobacco Use in the United States, 1900-1998

*Age-adjusted to 1970 US standard population.

Cumulative risk at UK male 1990 rates
BMJ 2000;321:323–9
UNITED KINGDOM 1950–1999: Males & Females
Lung cancer mortality at ages 35–44

Death rate /100 000 men, age standardised

Males
Females

Source: WHO mortality & UN population estimates

Mean of annual rates in component 5-year age groups

11th ETH Conference on Combustion Generated Nanoparticles
Characteristics of Particulates by Mass und Number Concentration

- Mass
- Number

i.e.: particulates generated by diesel

Kreyling et al., GSF-IHB
Particulate Matter (PM)-Emissions in CH

- **PM$_{10}$ 2000:** ca. 23‘000 Tons
  - 2010 Trend: ca. 21‘000 Tons
  - 2010 max.: ca. 14‘000 Tons

- **PM$_{2.5}$ 2000:** approx. 13-17‘000 Tons

- **Soot 2000:** approx. 4400 Tons

P. Straehl MPH, BAFU
Angriffsorte des Feinstaubs in den Atemwegen: Je kleiner die Partikel, desto tiefer dringen sie in das Lungensystem ein.
Air Pollution and Premature Death Worldwide

- 600‘000 death / year
- 1% of all cardiovascular deaths
- 3% of all respiratory tract cancers

- 7.4 Mio DALY’s / year

BMJ 2002, Culland, WHO Report
CH and PM induced health effects

- 3700 premature deaths / y
- 3 Mio citizens inhale too much PM
- 14% of Lung Cancer attributed to PM$_{2.5}$
  - 10mg / m³ median
- 270 Lung Cancer death / y (100 – 450)

P. Straehl MPH, BAFU
Cancer risk due to Air pollution in CH

- Life time risk: $3/1000 \left(3 \times 10^{-3}\right)$
- Allowed USG: $1-10/100'000 \left(1 \times 10^{-5}\right)$
  - 30-300 fold excess !
- Needed Reduction of "Soot“ : 30fold
- Needed Reduction of "PM_{2.5}“ : 50%

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CH 2000: PM$_{2.5}$ - Sources

- Agriculture: 28%
- Industry: 33%
- Traffic: 25%
- Household: 14%
Efficiency of DP-Filtre

- Diesel Particle Filter is able to eliminate 90% of PM mass
- 99% of PM$_{2.5}$ particles (number concentr.)
- 90% Reduction of carcinogenic potential
Highly efficient Diesel Particle Filter

Partikelanzahl um ca. 3 Grössenordnungen vermindert

T. Cerny,
Kantonsspital St.Gallen – ein Unternehmen, drei Spitäler. St.Gallen Rorschach Flawil
WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide

Global update 2005

Summary of risk assessment
Guidelines

\begin{align*}
\text{PM}_{2.5} : & \quad 10 \, \mu g/m^3 \text{ annual mean} \\
& \quad 25 \, \mu g/m^3 \text{ 24-hour mean} \\
\text{PM}_{10} : & \quad 20 \, \mu g/m^3 \text{ annual mean} \\
& \quad 50 \, \mu g/m^3 \text{ 24-hour mean}
\end{align*}

UF: Ultrafine particles <0.1μm not jet considered
### Table 1

**WHO air quality guidelines and interim targets for particulate matter: annual mean concentrations**

<table>
<thead>
<tr>
<th></th>
<th>$\text{PM}_{10}$ ($\mu g/m^3$)</th>
<th>$\text{PM}_{2.5}$ ($\mu g/m^3$)</th>
<th>Basis for the selected level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interim target-1 (IT-1)</td>
<td>70</td>
<td>35</td>
<td>These levels are associated with about a 15% higher long-term mortality risk relative to the AQG level.</td>
</tr>
<tr>
<td>Interim target-2 (IT-2)</td>
<td>50</td>
<td>25</td>
<td>In addition to other health benefits, these levels lower the risk of premature mortality by approximately 6% [2–11%] relative to the IT-1 level.</td>
</tr>
<tr>
<td>Interim target-3 (IT-3)</td>
<td>30</td>
<td>15</td>
<td>In addition to other health benefits, these levels reduce the mortality risk by approximately 6% [2–11%] relative to the IT-2 level.</td>
</tr>
<tr>
<td>Air quality guideline (AQG)</td>
<td>20</td>
<td>10</td>
<td>These are the lowest levels at which total, cardiopulmonary and lung cancer mortality have been shown to increase with more than 95% confidence in response to long-term exposure to $\text{PM}_{2.5}$.</td>
</tr>
</tbody>
</table>
PM2.5 concentration in Switzerland in 2000

Annual mean concentration
Grid cell size 400 m x 400 m
PM2.5 concentration in Switzerland in 2010 (‘business as usual’ scenario)

Annual mean concentration
Grid cell size 400 m x 400 m

Concentration in μg/m³
- < 5
- 5 - 7.5
- 7.5 - 10
- 10 - 12.5
- 12.5 - 15
- 15 - 17.5
- 17.5 - 20
- 20 - 22.5
- 22.5 - 25
- > 25

Swiss Agency for the Environment, Forests and Landscape
Air Pollution Control and NIR Division

Land use statistics 1992/97, BFS/GEOSTAT
Country border, BFS/GEOSTAT/L+T
z2010a/l_pm25_400

Bern, 18-JUL-2003
PM2.5 concentration in Switzerland in 2010 (‘maximum feasible reduction’ scenario)

Annual mean concentration
Grid cell size 400 m x 400 m
Reachable Goals for Switzerland:

- Reduction of 640 premature deaths including 60 lung cancer deaths/year
- + much more in morbidity reduction!
  - Costs: 300 Mio/year
- Savings: 1‘600 Mio/year and of course reduction of unnecessary suffering

Dr. Peter Straehl MPH, BAFU