PM Matters - What More Do We Need to Know?

Air Pollution and Regulatory Challenges Ahead in the EU: Research That Can Make a Difference

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**PM$_{10}$ concentrations in relation to the daily limit value in 2014 in the EU-28**

The 36$^{th}$ highest daily mean (EU Limit Value = 50 µg/m$^3$, EU Directive 2008)
Annual mean PM$_{2.5}$ concentrations, 2014

PM$_{2.5}$ annual mean Limit Value = 25 µg/m$^3$

WHO AQG = 10 µg/m$^3$

AQG = Air Quality Guideline
Trends in PM$_{2.5}$ annual mean concentrations by station type, EU, 2006-2014

µm/m$^3$ per year
Clean Air Policy Package for Europe

• Review of the Clean Air for Europe policy from 2005 conducted in 2011-2014
• Update on health effects (WHO, 2012-2013)
  • Review of evidence on health aspects of air pollution – REVIHAAP
  • Health risks of air pollution in Europe – HRAPIE
• Cost-benefit analysis (Holland 2014, IIASA 2013)
• Policy discussion setting objectives for 2025-2030
National Emission Ceiling Directive 2016/2284/EU

Objective: cut the health impacts of air pollution by half compared with 2005
Source contributions to ambient PM$_{2.5}$ at urban traffic stations in Germany and Poland, in the base year 2009 and for 2030 assuming adoption of the Clean Air Policy Package.
## Strength of evidence on health effects of PM$_{2.5}$, NO$_2$ and O$_3$

Systematic reviews:
- for PM: US EPA 2009
- for O$_3$: US EPA 2013

### C – causal
### L – likely causal
### S – suggestive for causal

<table>
<thead>
<tr>
<th>Outcome</th>
<th>PM$_{2.5}$</th>
<th>NO$_2$</th>
<th>O$_3$</th>
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<tbody>
<tr>
<td></td>
<td>Long</td>
<td>Short</td>
<td>Long</td>
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<tr>
<td>Total mortality</td>
<td>C / C</td>
<td>C / C</td>
<td>S / S</td>
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<tr>
<td>CV$^1$ mortality</td>
<td>C / C</td>
<td>C / C</td>
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<tr>
<td>Respiratory mortality</td>
<td>C / -</td>
<td>C / C</td>
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<tr>
<td>Lung cancer</td>
<td>- / L / C$^2$</td>
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<tr>
<td>Respiratory effects</td>
<td>L / L</td>
<td>L / C</td>
<td>L / L</td>
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<td>CV$^1$ effects</td>
<td>C / C</td>
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$^1$ CV = cardiovascular; $^2$ IARC 2013 (Group 1)
Age-standardized death rates / 100,000 pop. attributable to PM$_{2.5}$ in Europe

EEA: > 400,000 premature deaths / year attributed to PM exposure in the EU28 (2013)

https://www.stateofglobalair.org/data
Health-based reasons to reduce the health risk of air pollution in EU

✓ Causality of exposure
✓ Burden of disease / risk assessment

ACT NOW!!!
The evidence is sufficient!

- Driving forces (economy)
- Pressures (emissions)
- State (concentrations)
- Exposure
- Effects
Evidence: sufficient ≠ complete
Demand for local evidence on health effects of air pollution

Arguments for local studies:

• Local exposure or health conditions differ from that in other settings;

• Need to convince local authorities and the public about the scale of air pollution problem with local data.

Arguments against:

• Insufficient power / quality of local study;

• Time, costs, expertise…

• Delay in coping with the problem.
Research to improve exposure – response functions

- *Further studies in Europe and N. America:* increase precision of health risk assessment (HRA), especially in low exposure levels;

- *Studies in low/medium income regions:*
  - increase confidence in HRA results in medium – high exposures;
  - confirm applicability of exposure response function in local conditions;

- Identification of the role of PM components and sources (e.g. coal combustion, traffic, desert dust) – focus on the most effective strategy to cope with pollution;

- Studies examining effects of multiple pollutants: enable consideration of possible confounding or synergistic effects of various pollutants.

**Multi-disciplinary collaboration!**
Studies on “novel” health outcomes affected by air pollution

- Emerging fields: child development, cognitive effects, …;
- Identify (new) susceptible / vulnerable groups;
- Complete burden of disease assessment (years lived with disability, productivity / wellbeing);
- Provide additional arguments for coping with pollution.
Studies to explain biological mechanisms of effects

• Epidemiologic studies of early indications of disease conditions, e.g.
  • Cardiovascular indicators;
  • Epigenetics?
  • Changes in brain?
  • …
• Epi studies of vulnerable groups (cardiovascular disease, COPD patients, diabetics);
• Clinical controlled exposure studies;
• Exposome (including metabolic factors, hormones, oxidative stress, … )?

Understanding of disease causation; Improvement of disease prevention.
Accountability research

- Monitoring of effects of intervention (changes in emissions, air quality, exposure and health);
- Use of randomized control design (when feasible);
- Identification of conditions of effective interventions (including social and environmental characteristics of the target population);
- Optimization of interventions from public health point of view;
- Information / communication / policy support for effective intervention.

Multi-disciplinary collaboration!
Conclusions

1. Primary (current) concerns:
   • Current health burden of air pollution;
   • Slow implementation of existing air quality legislation;
   • Challenges in achieving new emission reduction targets.

2. Research which can (?) make difference:
   • Local evidence on health effects of air pollution;
   • Improvement of concentration response functions to increase reliability and precision of health burden estimates;
   • Identification, understanding and quantification of air pollution “novel” health effects – potential impact on burden of disease estimates;
   • Identification of the most feasible, socially acceptable and effective approaches to air pollution reduction to comply with current EU legislation and beyond.