REVIHAAP
Review of Evidence on Health Aspects of Air Pollution
HRAPIE
Health Risks of Air Pollution in Europe

JOAQUIN CONFERENCE
University of Leicester May 2014

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Trends in Knowledge and WHO Guidelines over Three Decades

Knowledge (arbitrary scale)

~ 50% Reduction in GL levels

1980

AQG 1987

1987

AQG 2000

2000

AQG 2005

2005

REVIHAAP 2013

Time

Courtesy Michal Krzyzanowski - modified
From Science to Policy

1. Hazard identification
2. Exposure-response
3. Health impact assessment for specified exposure scenarios
4. Cost-effectiveness and cost-benefit analyses to explore options
5. Development of air quality strategy
6. Implementation of appropriate measures
7. Evaluation of benefits ("accountability")

Environmental Hazard Assessment

EVIDENCE FROM POPULATIONS

ASSOCIATIONS:
Air pollution and health

EXCLUDE:
Chance, Bias Confounding

OTHER EVIDENCE (TOXICOLOGY)

APPLY:
Scientific reasoning

JUDGEMENT:
Causality

POLICY

Temporality
Dose response
Consistency
Coherence
Plausibility
Analogy

Size of effect
Specificity
REVIHAAP

Review of Evidence on Health Aspects of Air Pollution

• CONTEXT:
  – Comprehensive review of air quality legislation 2013

• SCOPE:
  – Scientific evidence for health effects.
  – Did not consider other aspects relevant to policy

• INVITED EXPERTS
  – Scientific Advisory Committee (8)
  – Expert authors (29)
  – External reviewers (32)
REVIHAAP TASK

To respond to 24 questions from the EC

– Answers: concise, clear
– To be directed at policy makers
– Supporting rationale: keep short as possible, base on systematic review of recent (since 2005) studies and systematic reviews
– Aim at consensus

REVIHAAP QUESTIONS

• PM, ozone, NO2, SO2, metals (As, Cd, Hg, Pb, Ni), PAHs

• Main focus of questions
  – New evidence on health effects
  – Concentration response functions and thresholds
  – Integration of evidence and policy implications
    • EU policies
    • WHO guidelines
  – Critical “data” gaps
## European Air Quality Standards

<table>
<thead>
<tr>
<th>Metric</th>
<th>CURRENT LIMIT VALUE</th>
<th>REVIHAAP</th>
<th>Relevant findings from evidence review</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>µg/m³</td>
<td>Averaging period</td>
<td></td>
</tr>
<tr>
<td>PM$_{2.5}$</td>
<td>25 target</td>
<td>1 yr</td>
<td>Previous evidence strengthened&lt;br&gt;New health outcomes suggested</td>
</tr>
<tr>
<td>PM$_{2.5}$</td>
<td>20 AEI reduction</td>
<td>3 yr average</td>
<td>Stronger evidence for low threshold, if any&lt;br&gt;Stronger evidence for differential toxicity&lt;br&gt;Concern about non tail-pipe emissions</td>
</tr>
<tr>
<td>PM$_{10}$</td>
<td>50</td>
<td>24 hr</td>
<td>Stronger evidence for hazard</td>
</tr>
<tr>
<td>PM$_{10}$</td>
<td>40</td>
<td>1 yr</td>
<td></td>
</tr>
<tr>
<td>NO$_2$</td>
<td>200</td>
<td>1 hr</td>
<td>Stronger evidence for hazard of both short- and long-term exposure.&lt;br&gt;Tend not to be explained by ass$^n$ with PM&lt;br&gt;Stronger case for causality</td>
</tr>
<tr>
<td>O$_3$</td>
<td>120</td>
<td>8 hr max</td>
<td>Stronger evidence for short-term hazard&lt;br&gt;More convincing evidence for long-term hazard&lt;br&gt;Threshold likely to be &lt;90 max 8 hrly mean</td>
</tr>
</tbody>
</table>

http://EC.europa.eu/environment/air/quality/standards.htm
### WHO Air Quality Guidelines 2005
#### REVIHAAP implications for AQG revisions

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<th>Metric</th>
<th>CURRENT AQG</th>
<th>REVIHAAP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PM_2.5</strong></td>
<td>10 µg/m³</td>
<td>1 yr</td>
</tr>
<tr>
<td><strong>PM_10</strong></td>
<td>20 µg/m³</td>
<td>1 yr</td>
</tr>
<tr>
<td><strong>O\textsubscript{3}</strong></td>
<td>100</td>
<td>8 hr max</td>
</tr>
<tr>
<td><strong>NO\textsubscript{2}</strong></td>
<td>40</td>
<td>1 yr</td>
</tr>
</tbody>
</table>
CRITICAL DATA GAPS (A7 / C9)

- Assimilation of evidence
  - Ongoing, systematic, critical, quantitative
- Air pollution as a complex mixture:
  - Better characterisation
  - Multi disciplinary study (supersites?)
  - Multi-pollutant models
- Improved exposure assessment
  - Modelling vs measuring more components
- Susceptible groups
HRAPIE
Health Risks of Air Pollution in Europe

A3, B3, C4
PM, O3 and NO2
Health outcome-pollution pairs for health impact assessment?

A5
PM2.5
Latest evidence on thresholds and linearity?

B2
O3
New evidence as to threshold?

D5
What concentration-response functions for key pollutants should be included in cost-benefit analyses supporting revision of EU air quality policy?
HRAPIE
Desiderata

• Causality
• Systematic review of relevant literature
• Defendable selection of crf
  – Major good study
  – Meta-analysis
• Correspondence with exposure data
• Baseline data available
## HRAPIE Recommended HIA - summary

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Exposure</th>
<th>Core analysis</th>
<th>Sensitivity analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM2.5</td>
<td>Long</td>
<td>Mortality: cause-specific (IHD, CVs, COPD, LCA)</td>
<td>Mortality, all-cause</td>
</tr>
<tr>
<td></td>
<td>Short</td>
<td></td>
<td>Mortality: all-cause, CVD, Resp; Morbidity (several outcomes)</td>
</tr>
<tr>
<td>O3</td>
<td>Long</td>
<td>Mortality: Resp.</td>
<td>Mortality: all-cause</td>
</tr>
<tr>
<td></td>
<td>Short</td>
<td>Mortality: CVD, Resp.</td>
<td>Mortality: all-cause</td>
</tr>
<tr>
<td>NO2</td>
<td>Long</td>
<td>Mortality: all-cause; Hospital admissions: Resp.</td>
<td>Mortality: all-cause, CVD; Asthma prevalence</td>
</tr>
<tr>
<td></td>
<td>Short</td>
<td></td>
<td>Hospital admissions: CVD</td>
</tr>
</tbody>
</table>
HRAPIE Report


Héroux M-E et al
Concentration-response functions for cost–benefit analysis of particulate matter, ozone and nitrogen dioxide as input to the revision of the European Union air policies: WHO project “Health risks of air pollution in Europe – HRAPIE”
EC Clean Air Package
December 2013
http://ec.europa.eu/environment/air/clean_air_policy.htm

• Clean Air Programme for Europe
  – To meet existing targets in short term
  – New air quality objectives in longer term (2030)

• Revised National Emissions Ceilings Directive
  – Stricter ceilings for the 6 main pollutants

• New Directive to reduce pollution from medium-sized combustion plants
Thanks