Clean air in urban spaces is possible - if you want it

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ETH SSPH+ Lecture Series – This is Public Health
Zoom lecture 23.3.2022 – 18:15h
https://us06web.zoom.us/j/82245904939?pwd=bXhPd3ZidzIaRHRwK3p5TEprdmt3QT09
Passcode: 534252
key questions of the Evidence Based Public Health Cycle (example of ambient air pollution)

- **A**
  - Air Pollution Exposure
    - (measuring, monitoring, modelling)

- **B**
  - Health Effects
    - (toxicology, epidemiology)
    - Is there a causal link?

- **C**
  - Public Health Impact
    - (attributable to air pollution)
    - Is it relevant for health in the society?

- **D**
  - Clean Air Policies
    - Emission control, air quality standards etc.
  - Do policies improve air quality & health?

- **E**
  - What can be done?
Combustion is with us...

SOURCES OF AMBIENT AIR POLLUTION
“Particulate Matter” (PM) by size (diameter, in micrometers)
WHY to keep air clean?

• Visibility
• Health
• Crop
• Buildings
• Economic losses
Systemic responses
- Altered chemokine signaling, inflammation
- Circulating extracellular vesicles
- Circulating RNA species
- Altered metabolites

Circulating peripheral white blood cells
- Altered composition and states
- Epigenetic changes
- Mitochondrial dysfunction
- Telomere attrition

Lung
- Inflammation, cell death
- Epigenetic changes
- Immune cell interactions
- Altered lung microbiome
- Virus activation

Brain
- Neuroinflammation
- Neurotoxicity
- Stress hormone release
- Endocrine disruption
- Circadian rhythm disruption
- Altered nervous system function

Heart
- Inflammation, cell death
- Epigenetic changes
- Mitochondrial dysfunction
- Altered autonomous nervous system function

Gut
- Altered gut microbiome
- Altered metabolites

Skin
- Inflammation
- Epigenetic changes
- Immune cell interactions
- Altered skin microbiome

Review

Hallmarks of environmental insults

Annette Peters,1,2,3,* Tim S. Nawrot,4,5 and Andrea A. Baccarelli6

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https://doi.org/10.1016/j.cell.2021.01.043
key questions of the Evidence Based Public Health Cycle (example of ambient air pollution)

A: Air Pollution Exposure (measuring, monitoring, modelling)

Is there a causal link?

B: Health Effects (toxicology, epidemiology)

Is it relevant for health in the society?

C: Public Health Impact (attributable to air pollution)

What can be done?

D: Clean Air Policies (emission control, air quality standards etc.)

Do policies improve air quality & health?
Environmental factors: leading global killers
Landrigan et al / GBD, Lancet 2017

... and 2/3 of environmental burden is due to air pollution

Figure 5: Global estimated deaths by major risk factor and cause, 2015
Using data from the GBD Study, 2016.41
Is there a causal link?

Air Pollution Exposure
(measuring, monitoring, modelling)

Health Effects
(toxicology, epidemiology)

Is it relevant for health in the society?

Clean Air Policies
Emission control, air quality standards etc.

Public Health Impact
(attributable to air pollution)

What can be done?

Do policies improve air quality & health?

key questions of the Evidence Based Public Health Cycle
(example of ambient air pollution)
HOW to keep air clean?

- Legal framework ("Clean Air Act")
- Stringent EMISSION standards (clean combustion)
- Science based Ambient AIR QUALITY standards
- Design, plan, adopt, enforce and monitor clean air MANAGEMENT PLANS (tailored to local needs)
New (Sept 2021) WHO Air Quality Guideline values

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Averaging time</th>
<th>2005 AQGs</th>
<th>2021 AQG level</th>
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<tbody>
<tr>
<td>PM$_{2.5}$, $\mu$g/m$^3$</td>
<td>Annual</td>
<td>10</td>
<td>5</td>
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<tr>
<td></td>
<td>24-hour$^a$</td>
<td>25</td>
<td>15</td>
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<tr>
<td>PM$_{10}$, $\mu$g/m$^3$</td>
<td>Annual</td>
<td>20</td>
<td>15</td>
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<tr>
<td></td>
<td>24-hour$^a$</td>
<td>50</td>
<td>45</td>
</tr>
<tr>
<td>O$_3$, $\mu$g/m$^3$</td>
<td>Peak season$^b$</td>
<td>–</td>
<td>60</td>
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<tr>
<td></td>
<td>8-hour$^a$</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>NO$_2$, $\mu$g/m$^3$</td>
<td>Annual</td>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>24-hour$^a$</td>
<td>–</td>
<td>25</td>
</tr>
<tr>
<td>SO$_2$, $\mu$g/m$^3$</td>
<td>24-hour$^a$</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>CO, mg/m$^3$</td>
<td>24-hour$^a$</td>
<td>–</td>
<td>4</td>
</tr>
</tbody>
</table>

$^a$8-hour average values

$^b$Seasonal peak average values

$\mu$g = microgram
MONITOR ambient air quality standards

1. Follow the link
2. Choose your «Favorit city» → what is the current air pollution index?
3. Write in the chat, CITY and VALUE

PS: Zurich Central today, 12:00h, was 27
During the past 30 years: how did ambient air quality change in the cities around the globe? It got:

A) much worse almost everywhere

B) much better almost everywhere

C) much better in Western countries and much worse in Asia and Africa
QUIZ QUESTION

During the past 30 years: how did ambient air quality change in the cities around the globe? It got:

A) much worse almost everywhere
B) much better almost everywhere
C) much better in Western countries and much worse in Asia and Africa
Trends in annual PM$_{2.5}$ concentrations 1990 – 2015
(for country trends: see Brauer et al ES&T2016)

with adoption of clean air policies
Trends in particulate matter concentrations 1986 – 2020 at the Swiss federal monitoring stations
Trends in annual PM$_{2.5}$ concentrations 1990 – 2015 (for country trends: see Brauer et al ES&T2016)
OUTLOOK

Globalization of

• Emission standards
• Ambient Air Quality Standards
Policies lag far behind science due to inaction of policy makers

% of countries with standards for at least ONE Pollutant

<table>
<thead>
<tr>
<th>Region</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>European Region</td>
<td>94%</td>
</tr>
<tr>
<td>South-East Asia</td>
<td>64%</td>
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<tr>
<td>Region of Americas</td>
<td>57%</td>
</tr>
<tr>
<td>Eastern Mediterranean Region</td>
<td>52%</td>
</tr>
<tr>
<td>Western Pacific</td>
<td>44%</td>
</tr>
<tr>
<td>African Region</td>
<td>36%</td>
</tr>
<tr>
<td>Total</td>
<td>60%</td>
</tr>
</tbody>
</table>
Swiss traders sell diesel with up to 630x higher sulphur content than what is allowed in Switzerland…

Sulphur levels as measured in «African Quality» diesel samples (ppm)
(See «Dirty Diesel» by the NGO «PublicEye»)
Public health calls for globalized TRENDS of IMPROVING AIR QUALITY!

with adoption of clean air policies

QUESTIONS?
Thank you

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