What's in the Air?
Port Alberni Air Quality and Health Forum

May 26, 2016

Dr. Michael Brauer
UBC Population and Public Health
Air pollution and health

- Ambient air pollution (individual) **risk** is small...but large **exposed population** = large population risk

- Drug abuse: Larger risk, smaller exposed population

- Major impacts are on chronic disease progression
Air pollution and health

- On **days** with worse air quality, more people die*

- In **more polluted cities**, people die earlier than in less polluted cities...

- ...and, in the **most polluted areas** of cities, there is an increased risk of dying

*out-of-hospital, >65 yrs
300,000 Adult Canadians (CCHS)  
8 – 11 year follow-up

No evidence of threshold above 1 µg/m3 minimum level

health impacts of air pollution:

- shorter life
- cognitive development
- cognitive decline
- mental health
- stroke
- heart disease
- asthma
- lung cancer
- reduced lung function
- obesity
- birth defects
- low birth weight
- diabetes

- established effects
- possible effects
Sources

- Waste burning
- Biogenic Sources
- Agriculture
- Agricultural & forest fires
- Stationary power generation
- Crustal material
- Metal industry
- Petrochemical industry
- Residential cooking
- Residential heating
- Solvent and paint use
- Road transportation
- Off-road transportation

Complex mixture

Natural processes
Particulate Matter

- **PM_{2.5}**: Combustion particles, organic compounds, metals, etc. < 2.5 μm (microns) in diameter
- **PM_{10}**: Dust, pollen, mold, etc. < 10 μm (microns) in diameter

**HUMAN HAIR**
- 50-70 μm (microns) in diameter

**FINE BEACH SAND**
- 90 μm (microns) in diameter

Image courtesy of the U.S. EPA
87% global population in areas exceeding WHO Air Quality Guideline (10 μg/m³ PM2.5 annual average)
8,800 deaths/yr PM2.5   680 deaths/yr ozone

Among top risk factors (#10 deaths, #11 DALYs)

CANADA (2013)

IHD, Stroke, Lung
Cancer, COPD, Lower
Respiratory Infections

Lancet. 2015 Sep 10; doi: 10.1016/S0140-6736(15)00128-4

http://vizhub.healthdata.org/gbd-compare
Woodsmoke

- 15% increase in SGA birth+
- 32% increase in otitis media++
- 8% increase in bronchiolitis*
- 15% increase in COPD hospitalization+

No associations with:
- pre-term birth-
- asthma incidence-
- cardiovascular, COPD mortality-

++ > traffic pollution, + ~ traffic, - < traffic

<table>
<thead>
<tr>
<th>Combustion Source</th>
<th>Emissions (mg/MJ)</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open fireplace</td>
<td>160 – 910</td>
<td></td>
</tr>
<tr>
<td>Conventional woodstove</td>
<td>50 – 2100</td>
<td></td>
</tr>
<tr>
<td>Conventional log boilers</td>
<td>50 – 2000 (50 – 250)</td>
<td></td>
</tr>
<tr>
<td>‘Modern’ woodstoves log/chip boilers</td>
<td>34 – 330</td>
<td></td>
</tr>
<tr>
<td>Pellet stoves/boilers</td>
<td>10 – 50</td>
<td></td>
</tr>
</tbody>
</table>

adapted from: Kocbach Bølling et al. 2009
New regulations

- 2016-17: Only wood and pellet stoves, boilers, furnaces certified to meet new US EPA or CSA emission standards legal to sell in B.C.
- 30 m setback for new Outdoor Wood Boilers (OWBs); Phase-out of older OWBs
- Prohibit burning of undesirable fuels, such as garbage, plastics and treated wood
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Dr. Sarah Henderson
BC Centre for Disease Control

For any inquiries/questions please contact: sarah.henderson@bccdc.ca
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Asthma MSP Billings within 5 days
July 1 – July 8

- Normal
- Unusual
- Rare
- PM2.5 stations
- Fires detected
Asthma MSP Billings
July 1 – July 8
Central Island
Ventolin® Prescriptions Filled
June 30 – July 7
Ventolin® Prescriptions
July 1 – July 8
Central Island
EXTRA SLIDES
Woodsmoke & multiple health measures

- 15% increase in SGA birth
- 32% increase in otitis media++
- 8% increase in bronchiolitis*
- 15% increase in COPD hospitalization+
- No associations with:
  - pre-term birth-
  - asthma incidence-
  - cardiovascular, COPD mortality-

++ > traffic pollution, + ~traffic, - <traffic

Measurement Scales

- We measure a few key ingredients of the complex mixture
- We mostly measure the background
- We capture time trends well
<table>
<thead>
<tr>
<th>Country</th>
<th>IHD</th>
<th>Stroke</th>
<th>COPD</th>
<th>Lung Cancer</th>
<th>ALRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>236,926</td>
<td>363,494</td>
<td>75,761</td>
<td>201,864</td>
<td>38,064</td>
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<tr>
<td>Household</td>
<td>151,722</td>
<td>256,674</td>
<td>295,786</td>
<td>75,050</td>
<td>28,041</td>
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<tr>
<td>India</td>
<td>296,489</td>
<td>139,941</td>
<td>56,665</td>
<td>21,432</td>
<td>72,041</td>
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<tr>
<td>Household</td>
<td>315,039</td>
<td>166,871</td>
<td>338,491</td>
<td>12,882</td>
<td>90,878</td>
</tr>
<tr>
<td>Canada</td>
<td>4,229</td>
<td>1,214</td>
<td>188</td>
<td>2,515</td>
<td>651</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cause</th>
<th>Total</th>
<th>Ozone: 681</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke</td>
<td>315,039</td>
<td>18%</td>
</tr>
<tr>
<td>COPD</td>
<td>338,491</td>
<td>45%</td>
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<td>12,882</td>
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<td>ALRI</td>
<td>90,878</td>
<td>22%</td>
</tr>
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<td>4,229</td>
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</tr>
</tbody>
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Total deaths: 916,102

Ozone: 681
POLLUTION MATTERS

Thousands of studies have shown how air pollution can harm people, causing heart attacks, lung problems and other ailments, and shortening lives. New research is finding possible links between certain pollutants and autism, birth defects and childhood obesity, among other conditions.

Caused by fine particles:
- Shorter life
- Learning disabilities
- Alzheimer’s
- Depression
- Stroke
- Autism
- Heart disease
- Asthma* 
- Lung cancer
- Reduced lung function
- Obesity
- Birth defects
- Low birth weight
- Diabetes

*Also caused by ozone.

[Staff Artist]
Global, Deaths attributable to Ambient particulate matter pollution  
Both sexes, All ages, 2013

<table>
<thead>
<tr>
<th>Cause</th>
<th>Deaths</th>
<th>Death Attribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>IHD</td>
<td>4,229</td>
<td>8.0%</td>
</tr>
<tr>
<td>Stroke</td>
<td>1,214</td>
<td>6.9%</td>
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<tr>
<td>COPD</td>
<td>188</td>
<td>1.5%</td>
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<tr>
<td>ALS</td>
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<td>COPD</td>
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<td>Prostate C</td>
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<td>Pancreat C</td>
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<td>Adult C</td>
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<td>Child C</td>
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<td>Iron</td>
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<td>TB</td>
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<td>HIV</td>
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<tr>
<td>Diarrhea</td>
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<td>COPD</td>
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Benefits of air quality management

- Air quality regulations benefit:cost ratios
  
  ~4:1 – 30:1

- Clean air rules responsible for majority of ALL estimated benefits (and costs) generated by Federal regulation

2.5 million Canadians, 16-year follow-up (1991 – 2006)
2.1 million non-immigrant Canadians (1991 long-form Census)

Mortality


- Portable HEPA filters 60% ↓ in indoor PM2.5
- ↑ endothelial function, ↓ inflammatory markers
• ~30% reduction in winter PM2.5
• ↓ in childhood wheeze, itchy eyes, sore throat, cold, bronchitis, influenza, throat infections
• School absence associations inconsistent

Libby, Montana stove exchange

95% of stoves exchanged

New stoves still relatively high emitters

~39% reduction in winter PM10
↓ winter cardiovascular (-19.6%) and respiratory (-27.9%) mortality
Similar decreases not observed in control community
Particle infiltration

Mean infiltration: 27% no filter, 10% with filter
Stove exchange and indoor levels

For each 5 µg/m³ increase in 3-day mean PM2.5, 6.0% increased risk of MI among elderly subjects (≥ 65 years).

Restricting to cold days and days with highest biomass contribution: 19% increased risk.

Preliminary results: Weichenthal et al.
Summary Points

- Woodsmoke exposure (acute, sub-chronic) associated with respiratory symptoms, increased medication, decreased lung function, asthma emergency room visits and hospitalizations
  - Larger responses amongst asthmatics

- Associations with CVD and respiratory mortality and CVD hospitalization are mixed
  - Supported by subclinical CVD measures
Summary Points (2)

- Limited studies of chronic exposure
- Associations with term birthweight, pre-term birth, incident infant bronchiolitis, otitis media and COPD hospitalization
- No association with COPD mortality or incident childhood asthma
- No studies of lung cancer
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• Associations with term birthweight, pre-term birth, incident infant bronchiolitis, otitis media and COPD hospitalization

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