Health Canada’s Approach to Indoor Air Contaminants

Vanessa J. Beaulac, M.Sc.
Section Head, Exposure Assessment Section
Safe Environments Directorate, Health Canada
Overview

- Government of Canada Air Program
- Indoor Air Contaminants Assessment Section
- Prioritization Process & Assessment
- Residential Indoor Air Quality Guidelines
- Indoor Air Reference Levels
- Research & Outreach
- Lessons Learned
Government of Canada – Air Program

- Air Health Science Division
- Air Health Effects Assessment Division
- Air Quality Health Index

- Air Quality Research Division

- Radiation Health Assessment Division

- Indoor Air Quality Group

Health Canada – Water & Air Quality Bureau

Environment & Climate Change Canada

National Research Council of Canada
Government of Canada – Indoor Air work

- Air Health Science Division
  - Indoor Air Contaminants Assessment
  - Exposure Assessment

- Health Canada – Water & Air Quality Bureau

- Health Canada – Chemicals Management Program
  - Existing Substances Risk Assessment Bureau
  - New Substances Assessment & Control Bureau

- Health Canada – Environmental Health Science and Research Bureau

- National Research Council of Canada
  - Indoor Air Quality Group

- Exposure and Biomonitoring Division
Indoor Air Contaminants Assessment Section (IACAS)

- The IACAS develops and promotes best practices to improve indoor air quality by assessing, researching, and communicating the health impacts of indoor air pollutants, and strategies to reduce exposure.

- Three interconnected activities:

**PURPOSE:** To evaluate health risks of specific pollutants in residential indoor environments and provide recommendations on how to reduce these risks.
Indoor Air

- Indoor air = *residential air*
- Excludes occupational exposures
- Currently we do not assess dust (Exposure and Biomonitoring Division; Existing Substances)
- Generate *voluntary* standards

**Chemical Classes of Interest**

- NO2, CO, CO2, O3, fine PM
- VOCs & Semi-VOCs
Chemical Identification – Indoor Air

Chemicals or broader issues are identified in consultation with other jurisdictions and with scientific partners:

- Provincial and Territorial partners
- Public Health Offices
- HC Bureaus
- Canadian Mortgage & Housing Corporation (CMHC)
- Indigenous Services Canada (ISC)

The latest research also guides our priorities identification.
Prioritization process

Screening

• List of identified chemicals is provided to a risk assessment specialist/company to screen, under contract
  – assess **hazard** using information from existing jurisdictions
  – do not assess exposure

• Give suggested recommendations for priority.

<table>
<thead>
<tr>
<th>Example</th>
<th>Contractor Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>carbon monoxide (CO)</td>
<td>Low</td>
</tr>
<tr>
<td>1,3-butadiene (1,3-BD)</td>
<td>Low</td>
</tr>
<tr>
<td>fine particulate matter (PM2.5)</td>
<td>High</td>
</tr>
<tr>
<td>benzene</td>
<td>Low</td>
</tr>
<tr>
<td>carbon tetrachloride (CCl4)</td>
<td>No</td>
</tr>
<tr>
<td>1,4-dichlorobenzene (DCB)</td>
<td>High</td>
</tr>
<tr>
<td>dichloromethane (DCM)</td>
<td>Low</td>
</tr>
<tr>
<td>isopropyl alcohol (IPA)</td>
<td>Low</td>
</tr>
<tr>
<td>naphthalene</td>
<td>High</td>
</tr>
<tr>
<td>tetrachloroethylene (TCE)</td>
<td>High</td>
</tr>
<tr>
<td>toluene</td>
<td>High</td>
</tr>
<tr>
<td>xylenes, mixture</td>
<td>High</td>
</tr>
</tbody>
</table>
Prioritization

• Our team then prioritizes the chemicals through the following process:
  o reviewing/assessing the content of the summary document;
  o mapping both hazard and exposure data using the Risk 21 approach and software;
  o comparing identified reference concentration(s) against available exposure data; and
  o ranking the chemicals for risk assessment based upon the results.
Prioritization

- First part of prioritization is **risk based**.

Subsequent non-risk considerations:

- the urgency from a population health perspective;
- the interest in the chemical by internal and external partners/jurisdictions;
- the resources required.
## Assessment

### Hazard
- Physico-chemical properties
- Animal toxicology (in vivo; in vitro)
- Epidemiology
- Modes of Action

### Endpoints:
- Cardiovascular, respiratory, neurological, reproductive / developmental, immunological, organ systems. Acute/Chronic
- Dosimetry analysis
  - PBPK models
  - Computational Fluid Dynamics

### Exposure
- Published literature
- Monitoring data (National Air Pollution Surveillance program) – ECCC (1969+; 286 sites)
- Emissions data - NRCC
- Health Canada Exposure Research
  - Residential Attached Garages Intervention Study
  - New homes pilot study
  - ToxIICS study
  - Cities studies (Halifax, Regina, Windsor, Toronto)
  - Cooking pilot study
Residential Indoor Air Quality Guidelines (RIAQGs)

Residential Indoor Air Quality Guidelines are quantitative exposure limits

- Based upon the outcomes of a Science Assessment
  - Classic risk assessment (Hazard + Exposure → Risk Characterization)
  - Summarize health effects, pollutant sources and exposure levels in Canadian homes.
  - Characterize the risks to health based on the best scientific data available.
  - Consider susceptible & vulnerable populations

If RIAQGs are not possible, we may be limited to qualitative recommendations (Residential Indoor Air Quality Guidance)
Indoor Air Reference Levels (IARLs)

- Developed to address volatile organic compounds (VOCs).

- Process requires:
  - Screening of *inhalation Reference Concentrations (RfC)* from other jurisdictions, followed by a critical analysis of endpoints and relevance.

- Thus, a suitable RfC may be selected as the Health Canada advised level (the IARL).

- Advantages of IARL process / IARLs:
  - Rapid assessment
  - May be used for establishing product emission standards

The IARL process may inform the need for further research and/or development of a full science assessment.
### RESIDENTIAL INDOOR AIR QUALITY GUIDELINES / GUIDANCE

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaldehyde</td>
<td>24 h avg: 280 µg/m³ (157 ppb) 1 hour avg: 1420 µg/m³ (795 ppb)</td>
</tr>
<tr>
<td>Benzene</td>
<td>as low as possible</td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>24 h avg: 11.5 mg/m³ (10 ppm) 1 h avg: 28.6 mg/m³ (25 ppm)</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>8 h avg: 50 µg/m³ (40 ppb) 1 h avg: 123 µg/m³ (100 ppb)</td>
</tr>
<tr>
<td>Mold</td>
<td>Address water damage quickly; remove visible mould</td>
</tr>
<tr>
<td>PM2.5</td>
<td>as low as possible</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>24 h avg: 10 µg/m³ (1.9 ppb)</td>
</tr>
<tr>
<td>Nitrogen dioxide</td>
<td>24 h avg: 20 µg/m³ (11 ppb) 1 h avg: 170 µg/m³ (90 ppb)</td>
</tr>
<tr>
<td>Ozone</td>
<td>8 h avg: 40 µg/m³ (20 ppb)</td>
</tr>
<tr>
<td>Toluene</td>
<td>24 h avg: 2.3 mg/m³ (0.6 ppm) 8 h avg: 15 mg/m³ (4.0 ppm)</td>
</tr>
</tbody>
</table>

### INDOOR AIR REFERENCE LEVELS

- 25 VOCs

### COMING SOON!

1) 1,2-dichloroethane (2018-19)
2) Carbon dioxide (2019)
3) Acrolein* (2019)
4) Ammonia
   - scoping the issue
5) SVOCs (various)
   - in prioritization stage
Regulatory Approaches?  

INDIRECT: Optimize our influence using other regulatory processes and non-regulatory standard development.

**HOW?**

Engage regulatory partners!

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Partner</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>CSA</td>
<td>CSA Standard for CO alarms</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>CSA</td>
<td>CSA standard for formaldehyde in composite wood products</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>RMB</td>
<td>Health Canada regulation for formaldehyde in composite wood products</td>
</tr>
<tr>
<td>O3</td>
<td>CSA</td>
<td>CSA standard for electrostatic air purifiers</td>
</tr>
</tbody>
</table>
Indoor Air Research

- Two groups involved with indoor exposure research at Health Canada:
  - Water and Air Quality Bureau:
    - Indoor Air Contaminants Assessment Section
    - Exposure Assessment Section
  - Environmental Health Science and Research Bureau
    - Biomonitoring (VOCs and dust)

- Both emissions tests and field exposure assessment are undertaken → Exposure data.
  - Exposure modeling
Indoor Air Research

ONGOING:

• First Nation Children’s Health Study
  – Partnership with the First Nations and Inuit Health Branch (Health Canada), the Children’s Hospital of Eastern Ontario, and the Canadian Mortgage and Housing Corporation to evaluate the effect of indoor environmental quality on children’s health in the Sioux Lookout Zone of Ontario.

• Ice Arenas Study
  – Evaluation of air quality in ice arenas in two provinces; intervention phase planned for winter of 2018/19.

• Emissions testing of composite wood products

• ToxIICS study
  – Infiltration study considering oxidative potential and source apportionment indoors:outdoors.
Indoor Air Research

PLANNED:

- New Homes Air Quality Study (2019-2021)
  - Evaluation of air quality in 40 new homes one-day prior to and following occupancy (24-h avg); and at 0, 3, 6, 9, 12 months (7-d averages).

- Cooking study (2019-2020)
  - Builds upon cooking intervention study; use of tracer gas monitors in addition to PM2.5 in NRCC twin homes to assess utility of range hoods (venting vs recirculating).
Outreach

- Website
  - [https://www.canada.ca/en/health-canada/services/air-quality.html](https://www.canada.ca/en/health-canada/services/air-quality.html)

- Fact sheets, pamphlets, infographics

- Virtual reality house tour

- Participation in home shows, medical conferences, health inspector conferences, federation of Canadian municipalities

- Direct contact with the public – phone calls and emails
Lessons Learned

- Priority setting is difficult, given the breadth of chemicals of interest.

- We can influence regulatory approaches, and voluntary standards are recognized.

- More data is better (research programs are important); but research must be of highest quality to be useful.

- Emissions data are scientifically very helpful (i.e., sources identification, identification of chemicals of most concern), but have not been used to drive regulatory efforts in Canada to date.

- Outreach, especially when considering risk management in vulnerable populations, is the most important outcome of our work.
  - Public awareness → behavioural changes.
Questions?