Population Health Surveillance and Forecasting for Wildfire Smoke

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Public health surveillance is the continuous, systematic collection, analysis and interpretation of health-related data needed for the planning, implementation, and evaluation of public health practice.

- Early warning system
- Evidence-based decision making
- Intervention evaluation

https://www.who.int/topics/public_health_surveillance/en/
Surveillance data for environmental health

- Environmental data
- Health data
- Vulnerability assessment
Environmental data for wildfire smoke exposure

- Air monitoring network
- Satellite images
- Model (near real time and forecast)
- Ensemble tools
Health data for wildfire smoke

What to consider?
• Spatial temporal resolution
• Availability
• Sensitivity to changes in smoke level
Temporal resolution

Daily averaged PM2.5 (μg/m³)

Sub-daily exposure: limited evidence

Short term (~days) exposure: sufficient evidence

Chronic exposure: little evidence
Data Availability

• Population covered
• Data quality
  • Missing data?
  • Standardized diagnosis?
  • Standardized data entry?
• Rate of update

Physician visits data:

- Date of visit
- Date of bill claim
- Date of data retrieval
Sensitivity to changes in smoke level

- Severity of the health outcome
- Outcomes in susceptible populations
Asthma related outcomes
Vulnerability assessment – susceptible population

- Age >65 or <5
- Pre-existing conditions

- Lower socio-economic status
- Pregnant women (unborn children)

Most supported by existing evidence

Less consistent but emerging evidence
Community health-vulnerability Index (USEPA)

Rappold AG, Reyes J, Pouliot G, Cascio WE, Diaz-Sanchez D. Community vulnerability to health impacts of wildland fire smoke exposure. Environmental science & technology. 2017 Jun 2;51(12):6674-82.
## Climate-related health hazard vulnerability assessment

- Vancouver Coastal Health and Fraser Health Region

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Sensitivity</th>
<th>Adaptive capacity</th>
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<tr>
<td>% days with PM$_{2.5}$&gt;25 during severe fire seasons</td>
<td>Pre-existing diseases</td>
<td>Immigrant status</td>
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<td></td>
<td>Age</td>
<td>Visible minority</td>
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<td>General self-rated health</td>
<td>Indigenous status</td>
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Wildfire Smoke Vulnerability
Metro Vancouver
Multiple data sources and data types can be hard to access and evaluate!

- Air monitor
- Smoke model
- Smoke forecast
- Fire information
- Baseline population asthma rate
- Population demographic data
- Asthma physician visits
- Asthma medication dispensations
- Satellite image
We need one system to integrate and visualize these information!
US CDC online tool

National Environmental Public Health Tracking Network (http://ephtracking.cdc.gov)

- Real time wildfire smoke predictions and forecasts from NOAA/National Weather Service (NWS)
- CDC's Social Vulnerability Index
- Static baseline health information
- **Potential health data: vital statistics, Medicare, hospital care (HCUP)**
British Columbia Asthma Prediction System (BCAPS)

- Observed air quality (Module 1)
- Observed health indicators (Module 3)
- Forecasted air quality (Module 2)
- Forecasted health response (Module 4)

Daily report
Provincial maps of forecasted PM$_{2.5}$ for today and tomorrow

Random forest model with
1. Lag1 PM$_{2.5}$ monitor
2. Lag1 remotely sensed smoke and fire
3. Lag 1 meteorology
4. FireWork smoke forecasts
HSDA report

The bottom panel:

- Observed PM$_{2.5}$ (M1)
- Range of PM$_{2.5}$ forecasts within the HSDA (M2)
HSDA report

The top panel:
- Observed counts with anomaly indicators (M3)
- Counts predicted using maximum of the PM$_{2.5}$ forecasts range (M4)
Areas to improve for surveillance

- Change from static reports to interactive platforms to suit needs of different users

https://dangerouspenguin.github.io/
Areas to improve for surveillance

- Data with higher temporal resolution
Need for long-term surveillance

More exposed

Time passes

Compare health outcomes

Less exposed
Contributors

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• Dr Sarah Henderson
• Kathleen McLean

UBC
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• Kaitlin Castellani
Thank you!

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Wildfire Smoke Sensitivity Index
Metro Vancouver
2018 Case Studies

* Note: The Nisga’a Health Council is an independant health authority

Prepared By: BCStats
July, 2008
Observed above expected

Predicted above expected

Predicted observed