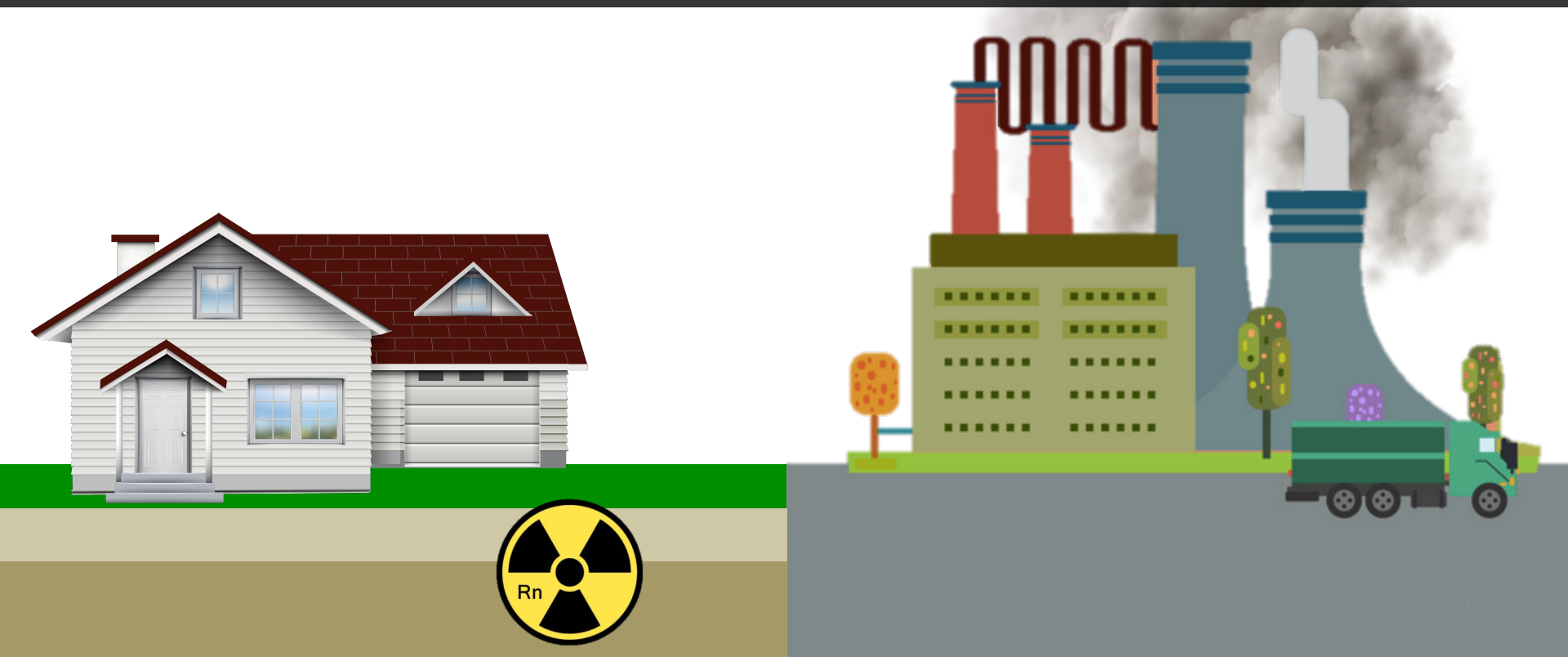
The burden of lung cancer in Canada attributable to residential radon and outdoor air pollution

Gogna P, Narain TA, O'Sullivan DE, Villeneuve PJ, Demers PA, Hystad P, Brenner DR, Friedenreich CM, King WD & the ComPARe team



Radon

Epidemiologic studies of miners helped establish the relationship between radon and lung cancer, and its classification as a Group 1 carcinogen by IARC.

In recent decades, the focus has shifted to residential radon, where large population-based studies consistently reported relationships between low-level residential radon exposure and increased lung cancer risk.

Air Pollution

Epidemiologic studies have consistently reported associations between various measures of air pollution and lung cancer risk, including $PM_{2.5}$.

$PM_{2.5}$ is classified by IARC as Group 1 (2013), and is a complex mixture containing a number of known carcinogens including polycyclic aromatic hydrocarbons (PAHs), and diesel exhaust.

Study Objectives

Estimation of the current joint burden of lung cancer attributable to residential radon and outdoor air pollution.

Predicting the future burden of lung cancer due to residential radon and outdoor air pollution under feasible exposure reductions

Methods-Quantifying Burden of Disease

Population attributable risk

The proportion of cancer incidence that can be attributed to a specific exposure.
Consequences of an exposure factor on disease occurrence at the population level.

Requires:

- Relative Risk
- Prevalence of exposure

Potential impact fraction

Reduction of a disease resulting from changing the current distribution of a risk factor to a modified distribution.

Requires:

- Relative Risk
- Prevalence of exposure
- Counterfactual exposure distribution

Methods-Radon

PREVALENCE
Use of Cross-Canada Survey of Radon Concentrations in Homes (2009-2010).

RELATIVE RISK
Pooled RR estimated from population-based studies of residential radon exposure.

Methods-Air Pollution

PREVALENCE
Satellite-derived and land use regression based modeling was used to estimate $PM_{2.5}$ at 1x1km resolution (Hystad et al., 2011).

RELATIVE RISK
Pooled RR from Canadian studies of $PM_{2.5}$ and lung cancer.

Results-Relative Risk Estimate Radon

RR: 1.16
(1.07-1.24)
per 100Bq/m^3 increase

Meta-analysis of 10 international studies assessing the relationship between residential radon and lung cancer.

Results-Relative Risk Estimate Air Pollution

RR: 1.09
(1.06-1.12)
per 10ug/m^3 increase in $PM_{2.5}$

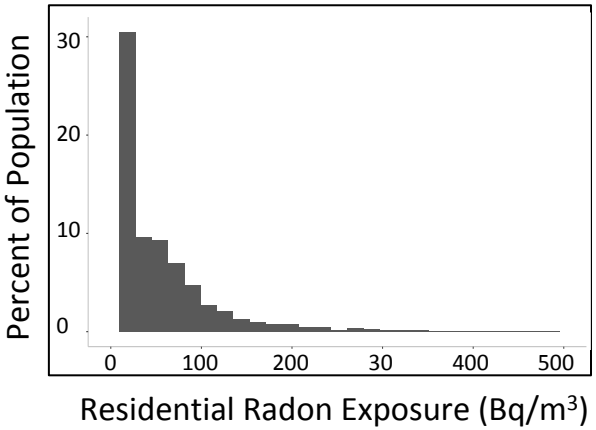
Meta-analysis of 6 Canadian studies assessing the relationship between $PM_{2.5}$ and lung cancer.

Results-Radon

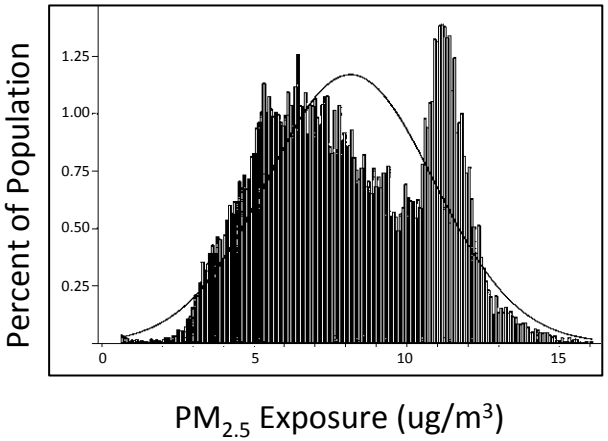
Exposure Distribution (1985-2009)

mean 44.4 Bq/m^3

geometric mean 19.4 Bq/m^3



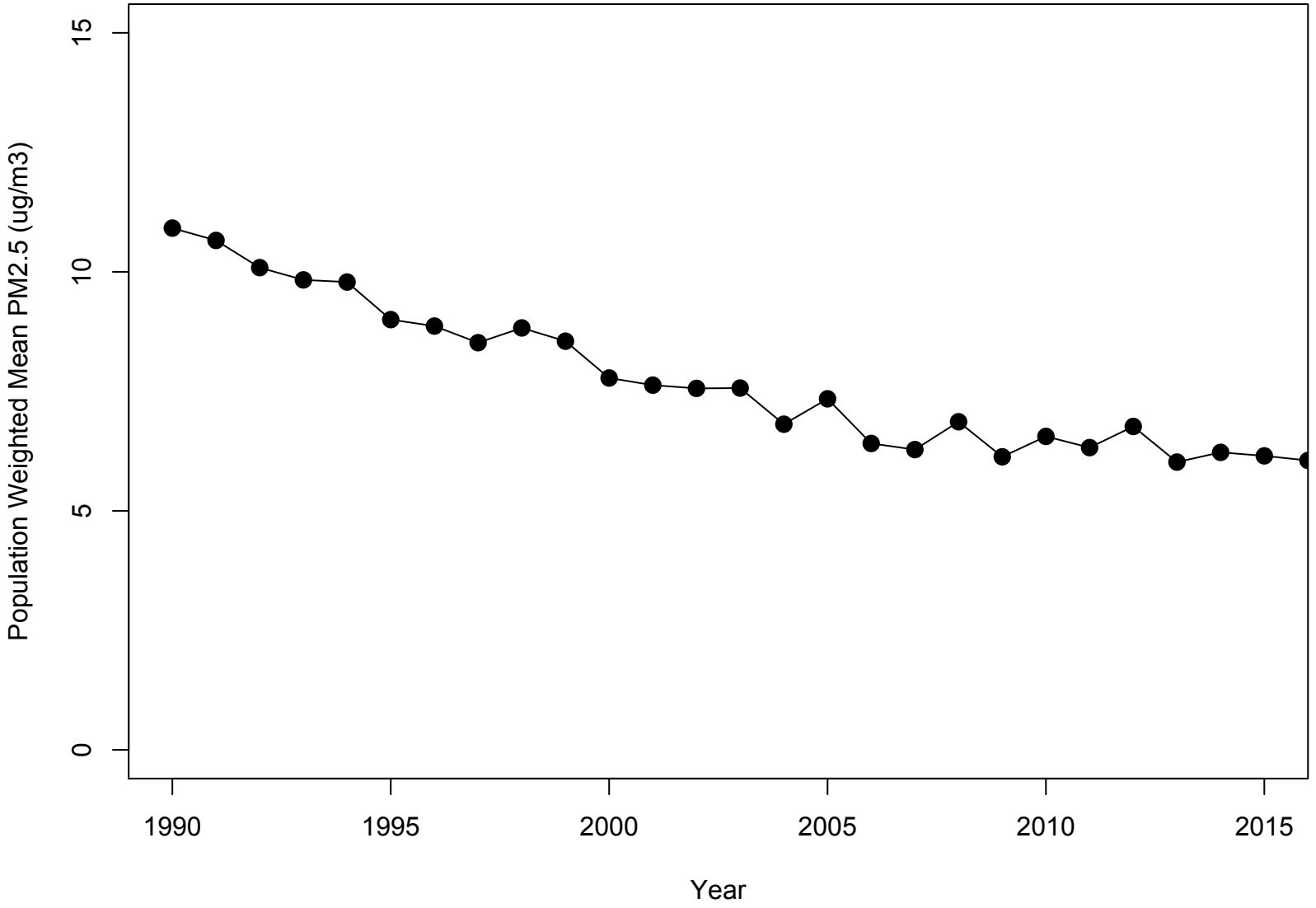
Results-Air Pollution



Exposure Distribution (1990-2009)

mean 8.3 µg/m^3

Results-$PM_{2.5}$ Levels in Canada Over Time



Results-The Current Burden

PAR FOR LUNG CANCER ATTRIBUTABLE TO RESIDENTIAL RADON (2015)

6.9%

PAR FOR LUNG CANCER ATTRIBUTABLE TO AIR POLLUTION (2015)

6.9%

PAR FOR LUNG CANCER ATTRIBUTABLE TO RESIDENTIAL RADON AND AIR POLLUTION (2015)

13.3%

NUMBER OF PREVENTABLE LUNG CANCER CASES IN CANADA (2015)

4,534

Results-The Future Burden

What if we could fully mitigate all residential radon exposures above WHO guidelines (100Bq/m^3) by 2038?

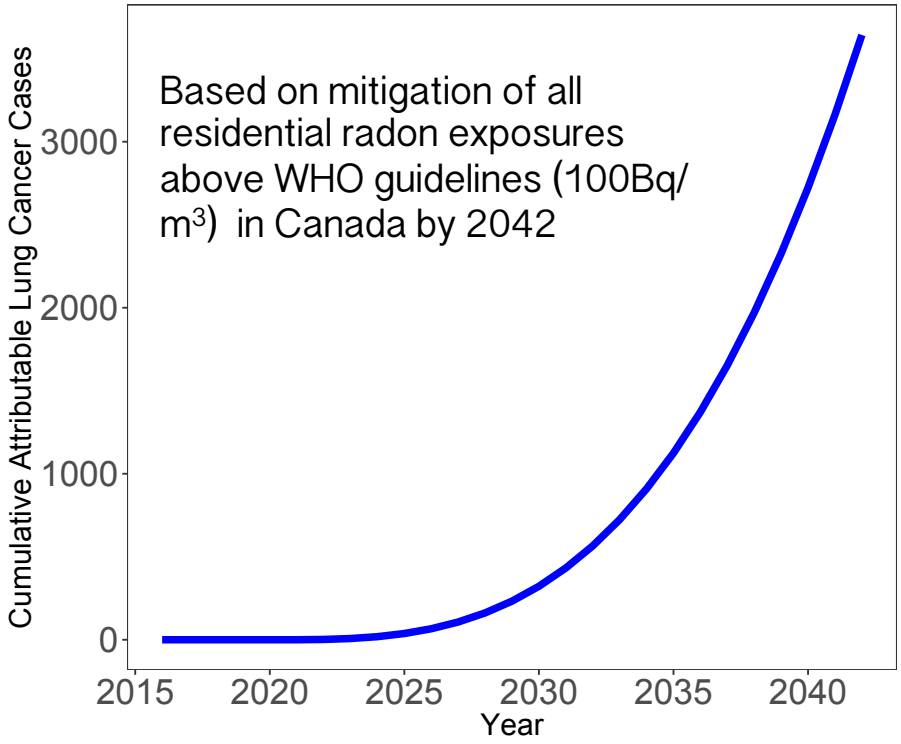
1.3% reduction in burden

What if we could reduce $PM_{2.5}$ exposure by 50% by 2038?

1.4% reduction in burden

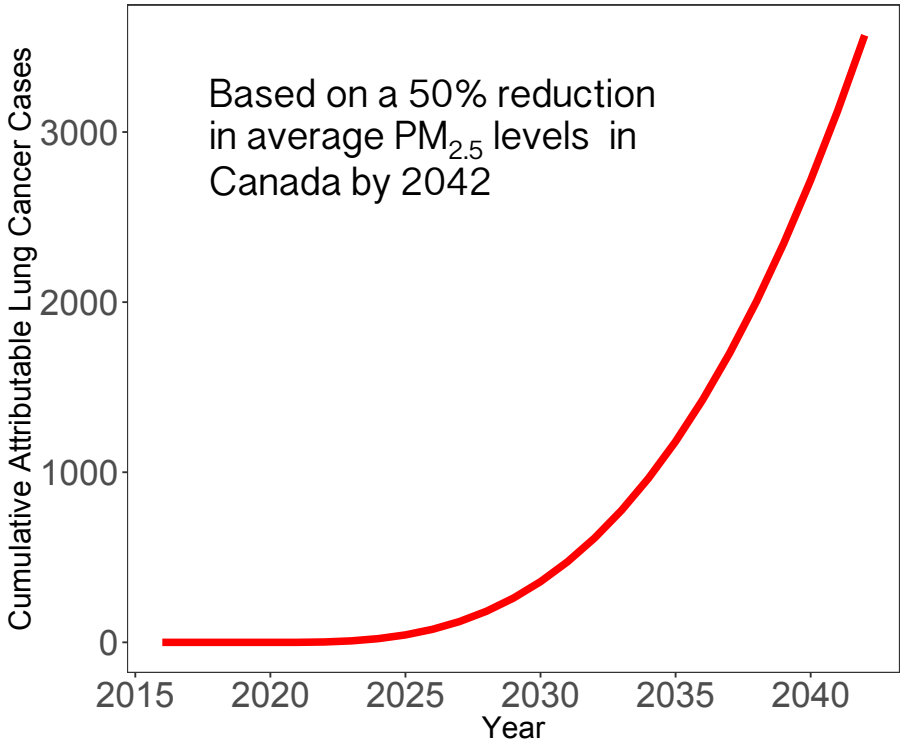
Results-The Future Burden

Future Preventable Lung Cancer Cases due to Residential Radon Exposure



3,568 cases could be prevented

Future Preventable Lung Cancer Cases due to $PM_{2.5}$ Exposure



3,643 cases could be prevented

Conclusion

Residential radon exposures can be reduced through radon monitoring and mitigation of exposure in homes through structural changes. Current Canadian guidelines may need to be re-examined based on evidence of increased risks beyond cut off of 200Bq/m^3.

Reductions in air pollution enjoyed in past decades through stricter regulations on industry and emissions tests for vehicles must be sustained if we are to have an impact on future burden.

Although it may seem like reducing environmental exposures over the coming decades does very little to reduce our cancer burden, these changes can be lead to large decreases in burden over time.

Thank You

Canadian Cancer Society

Co-Investigators

Christine Friedenreich, Alberta Health Services (Co-PI)
Darren Brenner, Alberta Health Services (Co-PI)
Stephen Walter, McMaster University
Eduardo Franco, McGill University
Will King, Queen's University
Paul Demers, Cancer Care Ontario
Paul Villeneuve, Carleton University
Prithwish De, Cancer Care Ontario
Robert Nuttall, Canadian Cancer Society
Leah Smith, Canadian Cancer Society
Perry Hystad, Oregon State University

COMPARE Team Members

Abbey Poirier, Alberta Health Services
Farah Khandwala, Alberta Health Services
Yibing Ruan, Alberta Health Services
Xin Grevers, Alberta Health Services
Karena Volesky, McGill University
Mariam El-Zein, McGill University
Shelia Bouten, McGill University
Tasha Narain, Queen's University
Dylan O'Sullivan, Queen's University
Zeinab El-Masri, Cancer Care Ontario