

# Lung Cancer Risks from Radon in Ontario: Burden of Illness, Estimates and their Policy Implications

Ray Copes, MD

Emily Peterson, MPH



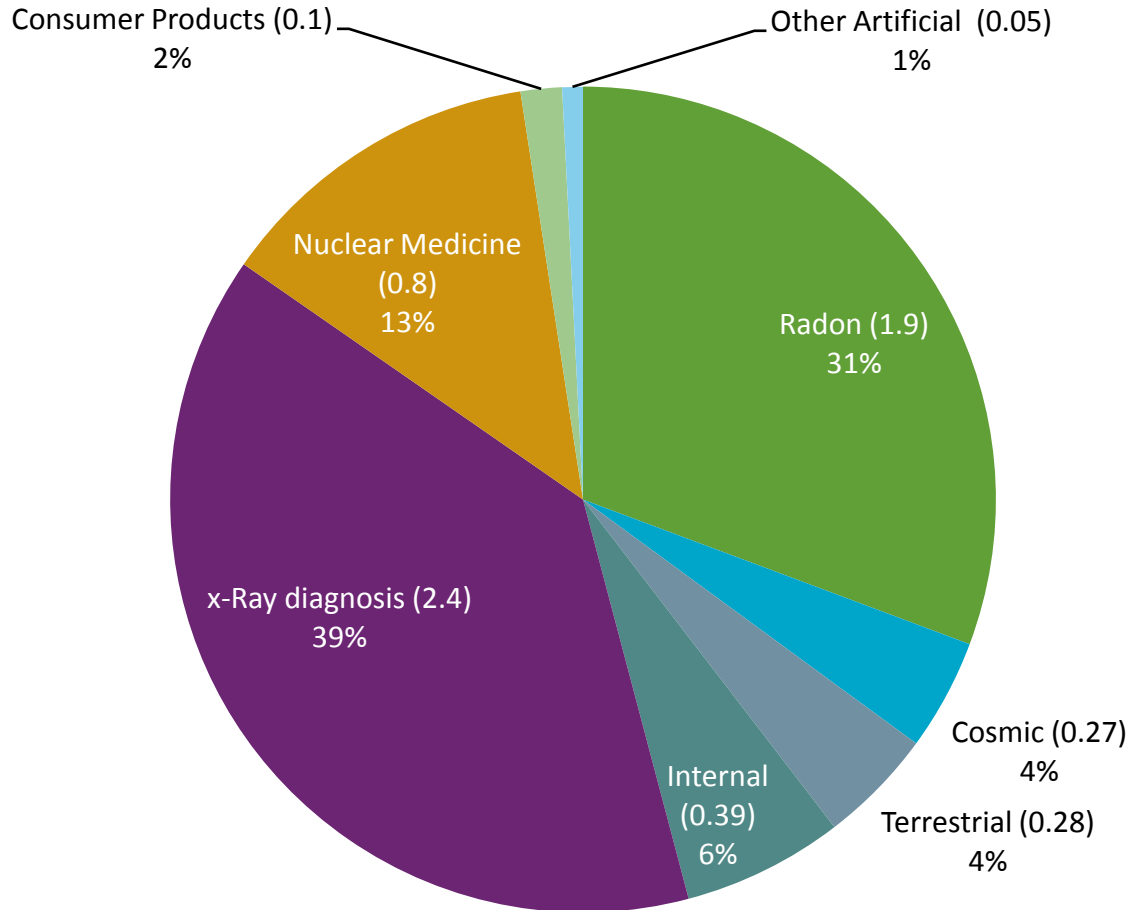
# PUBLIC HEALTH ONTARIO

- Arm's length agency funded by Province of Ontario
- Became operational in 2008
- Provide science and technical advice and support to the health care system (e.g. public health units) and the Government of Ontario
- Also run the Public Health Labs
- Do not have regulatory or statutory powers; do not make policy
- Research and teaching through links to, and appointments at, Ontario universities



# Radon in Context as source of Ionizing Radiation Exposure

## Average Amounts of Ionizing Radiation Received Annually by Resident of the United States or Canada (mSv)



Source: Adapted from Upton A C. Radiation. In: Frumpkin H, editor. Environmental Health: from global to local. (2nd Ed). John Wiley & Sons, Inc; 2010

## Lifetime Lung Cancer Risk (Adapted from the US EPA)

| Radon Level (Lifetime Exposures)                | People who never smoked | People who smoked |
|---|-------------------------|-------------------|
| 740 Bq/m <sup>3</sup>                           | 36/1,000                | 260/1,000         |
| 370 Bq/m <sup>3</sup>                           | 18/1,000                | 150/1,000         |
| 296 Bq/m <sup>3</sup>                           | 15/1,000                | 120/1,000         |
| 148 Bq/m <sup>3</sup>                           | 7/1,000                 | 62/1,000          |
| 74 Bq/m <sup>3</sup>                            | 4/1,000                 | 32/1,000          |
| 48 Bq/m <sup>3</sup>                            | 2/1,000                 | 20/1,000          |
| 15 Bq/m <sup>3</sup><br>(average outdoor level) |                         | 3/1,000           |

United States Environmental Protection Agency [homepage on the Internet]. A citizen's guide to radon. Washington, DC: United states Environmental Protection Agency; 2013 Jan 10 [cited 2013 Nov 20]. Available from: <http://www.epa.gov/radon/pubs/citguide.html#risk%20charts>. Available at: <http://www.epa.gov/radon/pubs/citguide.html#risk%20charts>.

# Why do Burden of Illness Estimates?

## How understandable is?

- IARC Group 1 carcinogen
- Second largest contributor to ionizing radiation exposure
- 200 Bq/m<sup>3</sup> or any other measure of radon
- % of homes above a given level



# Twelve Principal Outrage Components Sandman 1991

## “SAFE”

- Voluntary
- Natural
- Familiar
- Not Memorable
- Not Dreaded
- Chronic
- Knowable
- Individually controlled
- Fair
- Morally irrelevant
- Trustworthy source
- Responsive process

## “RISKY”

- Coerced
- Industrial
- Exotic
- Memorable
- Dreaded
- Catastrophic
- Unknowable
- Controlled by others
- Unfair
- Morally relevant
- Untrustworthy sources
- Unresponsive process

# How best to communicate to public and public health professionals?

- Context is important
- How do you relate to other worries, priorities?
- “How important is this?” is asked by many people, groups , organizations
- Frames of reference vary
- How many will get sick and/or die?
- Where does this fit? We can’t do everything!
- WHO Environmental Burden of Disease
- Other national, local efforts directed at all or some hazards

# Public Health System in Ontario

- Highly decentralized service delivery – 36 health units
- Ontario Public Health Standards common to all
- Some flexibility to tailor to local needs priorities
- Health Hazard Prevention and Management Standard
- Permissive not prescriptive
- Level of awareness and interest in radon varied across health units

# Ontario Radon Burden of Illness Calculations : Purpose

- Calculate the lung cancer burden of illness attributable to Radon in Ontario
- Estimated number of lung cancer deaths that can be prevented if all homes above 50, 100, 150 and 200 Bq/m<sup>3</sup> were remediated to background levels
- Perform calculations separately for each of the 36 health units in Ontario

## Data Sources

- Cross-Canada Survey of Radon in Homes (Health Canada)
- Proportion of pop. living in apartment buildings by health unit (Statistics Canada)
- Proportion of pop. ever-smokers by health unit (CCHS)
- All cause and lung cancer mortality by health unit (CCHS)
- RR for lung cancer mortality and all-cause mortality due to smoking (American Cancer Society)

## Results: Ontario Burden Estimates

- 13.6% (95% CI 11.0,16.7) of lung cancer deaths in Ontario attributable to radon
  - = 847 (95% CI: 686, 1039) radon-related lung cancer deaths in 2007
    - 85% of these in ever-smokers

## Results: Individual Health Unit Burden Estimates

| Geographic Region | Population Attributable Risk Percent (PAR%) | Lung Cancer Deaths Attributable to Radon | Number (percentage) of radon-attributable lung cancer deaths that can be prevented |                          |
|-------------------|---|--|--|--------------------------|
|                   | Mean (95% Confidence Interval)              |  | 100 (Bq/m <sup>3</sup> )   | 200 (Bq/m <sup>3</sup> ) |
| Ontario           | 13.6 (11.0-16.7)                            | 847                                      | 233 (28%)  | 91 (11%)                 |
| Health Unit 1     | 25.3 (21.7-29.6)                            | 21                                       | 9 (42%)  | 5 (23%)                  |
| Health Unit 2     | 9.1 (6.9-11.6)                              | 24                                       | 1 (4%)   | 0 (0%)                   |

## Results: Ontario Preventable Cancer Estimates

| Remediation Level                       | 50 Bq/m <sup>3</sup> | 100 Bq/m <sup>3</sup> | 150 Bq/m <sup>3</sup> | 200 Bq/m <sup>3</sup> |
|---|----------------------|-----------------------|-----------------------|-----------------------|
| Number of lung cancer deaths prevented  | 389                  | 233                   | 149                   | 91                    |
| Percent of lung cancer deaths prevented | 46%                  | 28%                   | 18%                   | 11%                   |



# IMPLICATIONS FOR POLICY

## Is test and remediate the best option?

- Good evidence that remediation is effective
- Literature mixed on effectiveness of education to promote testing and remediation in homes
  - Many barriers, few people remediate
  - Financial incentives may help
- Large portion of burden from exposures below the current Canadian guideline
- Only option for older homes
- What about public buildings?

# Building Codes

- Could reduce levels to well below the current guideline (address larger portion of burden)
- More consistent with ALARA?
- But, takes many years for housing turnover
- More research needed on effectiveness of building codes
- Impact of insurance companies?
  - Tarion now covers new builds with levels above Health Canada Guideline ( $>200\text{Bq}/\text{m}^3$ )

# Possible Public Health Responses

- Health Unit education/awareness campaigns?
  - Health Canada education materials available for free upon request
- Incentives for homeowners to test and remediate?
  - e.g. Rebate if provide testing results to HU
- Testing and remediation in public buildings (schools) and group facilities?
- Building codes?
  - National model construction codes

Gray, A., Read, .S., McGale, P., Darby S. (2009) Lunch cancer deaths from indoor radon and the cost effectiveness and potential of polities to reduce them. *BMJ* 338a3110  
Gagnon, F. Courchesne, M., Levesque B., et al. (2008) Assessment of the Effectiveness of Radon Screening Programs in Reducing Lung Cancer Mortality. *Risk Analysis*, 28(5): 1221-1229  
World Health Organization. (2009). WHO Handbook on Indoor Radon: A Public Health Perspective. [http://whqlibdoc.who.int/publications/2009/9789241547673\\_eng.pdf](http://whqlibdoc.who.int/publications/2009/9789241547673_eng.pdf)

## Why so little success to date?

- ‘Natural’, no organoleptic impact
- For private homes- alignment of those bearing risk and those responsible for testing/remediation
- Little ‘Outrage’
- Is government sending a mixed message?

# Acknowledgements

- Emily Peterson
- Amira Aker,
- Lennon Li
- JinHee Kim
- Kevin Brand

**THANK YOU!**