Occupational Cancer Research Centre

Occupational Exposure to Radon and Its Impact

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Towards a cancer-free workplace

Ontario Cancer Care Ontario Action Cancer Ontario

Canadian Cancer Society

Ontario Ministry of Labour Ministére du Travail

United Steelworkers USW Unity and Strength for Workers

Canadian Partnership Against Cancer / Partenariat canadien contre le cancer

Ontario Uranium Mining: 1955-1996

ONTARIO URANIUM MINING REGIONS

ELLIOT LAKE URANIUM MINES

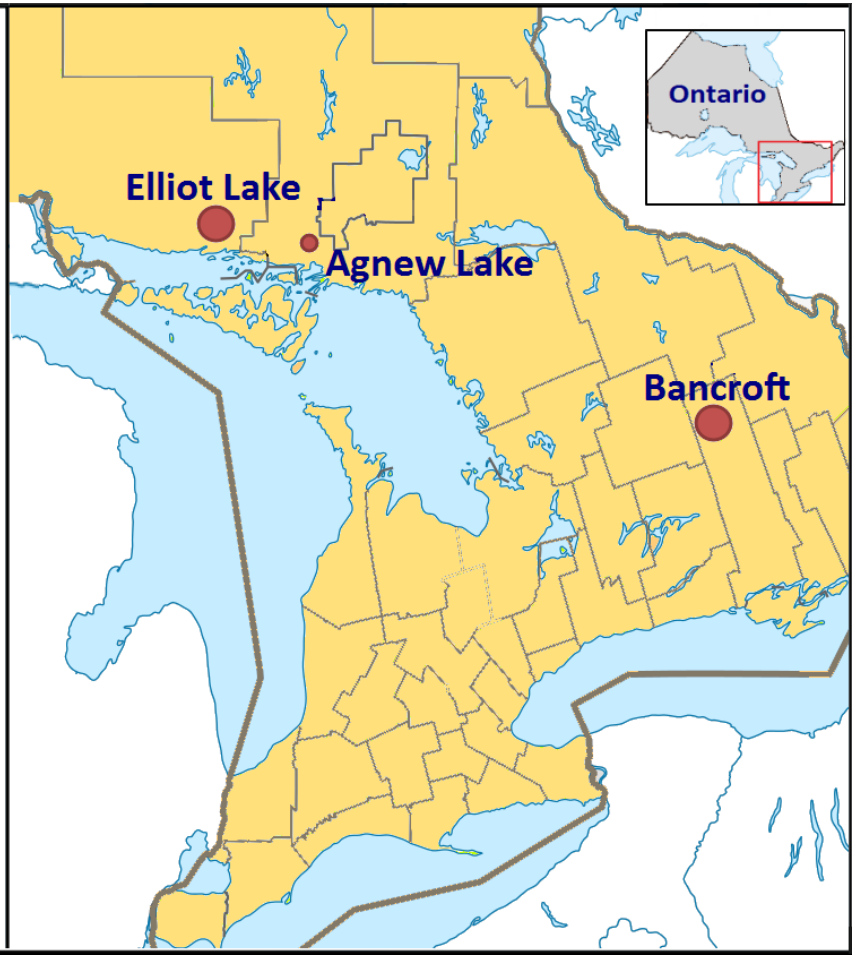
- Buckles
- Denison
- Can-Met
- Lacnor (Nordic Lake)
- Milliken
- Nordic
- Panel
- Pronto
- Quirke I (Old Quirke)
- Quirke II (New Quirke)
- Stanleigh
- Stanrock

AGNEW LAKE URANIUM MINES

- Agnew Lake

BANCROFT URANIUM MINES

- Bicroft
- Blue Rock
- Canadian Dyno
- Cavendish
- Greyhawk
- Nu-Age
- Madawaska (Faraday)
- Tory-Hill



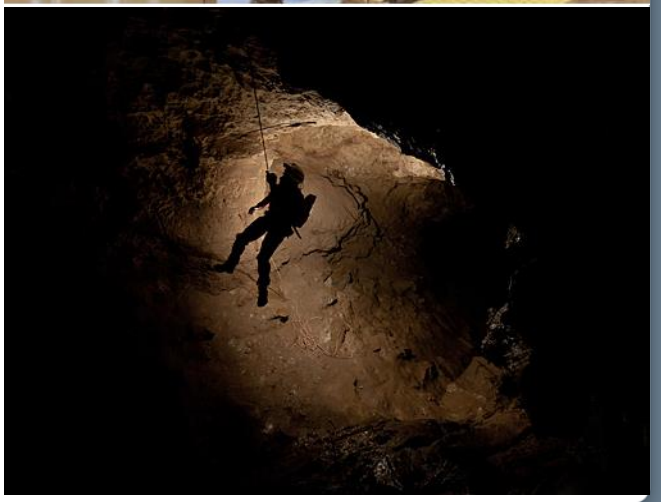
Update of the Ontario Uranium Miners Cohort

- 28,546 males, with a minimum of 1 week in the mines
- Mean of 5.3 years in the mines and 21 WLM exposure
- 8572 deaths
- 1246 lung cancer deaths

Underground work

Worksites that have measured higher levels of radon include:

- Non-uranium mines
- Subway/tunnel/ workers
- Underground nuclear depositories
- Caving
- Telecom cabling crews
- Electrical power generation
- Excavation



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Water-related worksites

Radon is soluble in water and can be released into air through aeration, bubbling, and mixing.

Water specific worksites that have been found to have high radon levels are:

- Fish Hatcheries
- Water Treatment Facilities
- Spas and Thermal Baths

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CAREX Radon database: Canadian studies and measurements, by industry

Industry	Province(s)	Measurements	Reports/ Studies
Uranium mining	ON, SK	18,925	2
Schools and daycare	BC, QC	901	2
Provincial government buildings	AB	520	1
Hospitals and long term care facilities	BC, NS	45	2
Oil and gas extraction and distribution	BC	25	1
Others (fish hatcheries, water treatment, scientific research and development, manufacturing, warehousing, electric power generation and transmission)	BC, MB, NS, ON	160	3

SUMMARY OF BC RADON SURVEY RESULTS COPES ET AL, RADON IN BC WORKPLACES,2009

LOCATION >	COASTAL REGION	INTERIOR REGION
Homes	Low in Radon <200 Bq/m^3	Low to High Radon Depends on Geology & Soil Type 0 - 40% >200 Bq/m^3; Max=7400 Bq/m^3
Schools	Not Tested	Low to High Radon Correlates with Radon in Surrounding Homes 0 - 40 % >200 Bq/m^3; Max = 3200 Bq/m^3
Daycares	Not Tested	Low to Moderate Levels Similar to surrounding schools 6 % > 200Bq/m^3; Max=225 Bq/m^3
Caves	Low in Radon 190-215 Bq/m^3	High in Radon 2800-3800 Bq/m^3; Avg = 3200 Bq/m^3
Care Facilities	Not Tested	Low to High Depending to Location in Building 96-1325 Bq/m^3
Fish Hatcheries	< 200 Bq/m^3 except in aeration towers (not normally occupied)	< 200 Bq/m3 if open to outside. Normally occupied areas ~ 450-900 Bq/m^3; Enclosed aeration tower ~ 12,000 Bq/m^3

Location-based Assessments

Worksites in specific geographical locations.

Nova Scotia: 21 worksites potentially at risk were studied, 2 had levels above 100 bq/m^3. Similarities between the two sites included no mechanical ventilation and little occupancy.

Quebec Schools: Geography the only relevant variable for selecting worksites to test. 17% of schools above guidelines.

BC Federal Buildings and First Nation's sites: 11% of First Nations buildings. 4% of federal buildings- research ongoing

Health Canada Radon Testing Results for Federal Buildings (as of 2011)*

Total number of Buildings	7239
Number of Buildings with average Radon below 200 Bq/m^3	6,887
Number of Buildings with average Radon between 200 and 600 Bq/m^3	301
Number of Buildings with average Radon above 600 Bq/m^3	51

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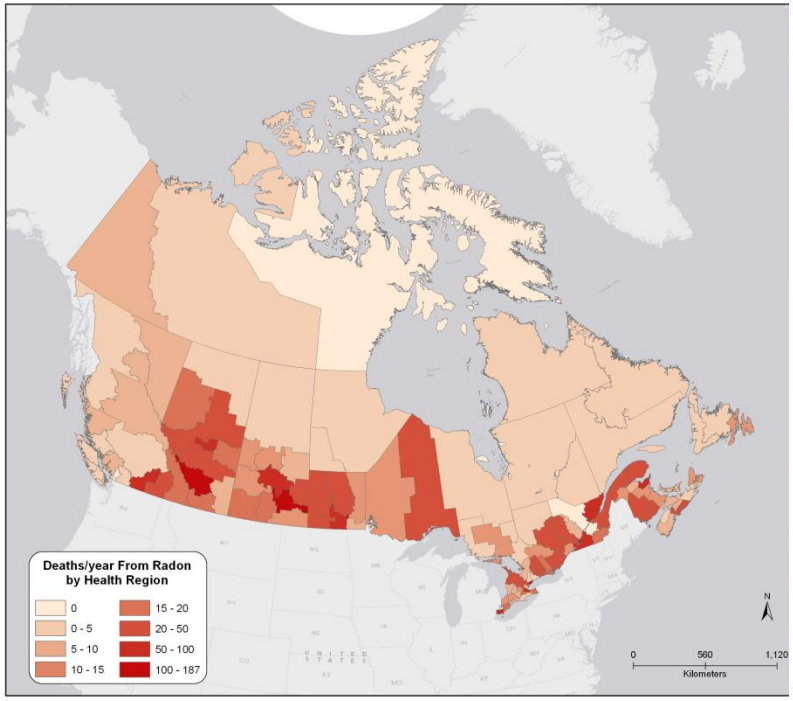
* Testing 2007-2011 using long-term (3 month) radon detectors

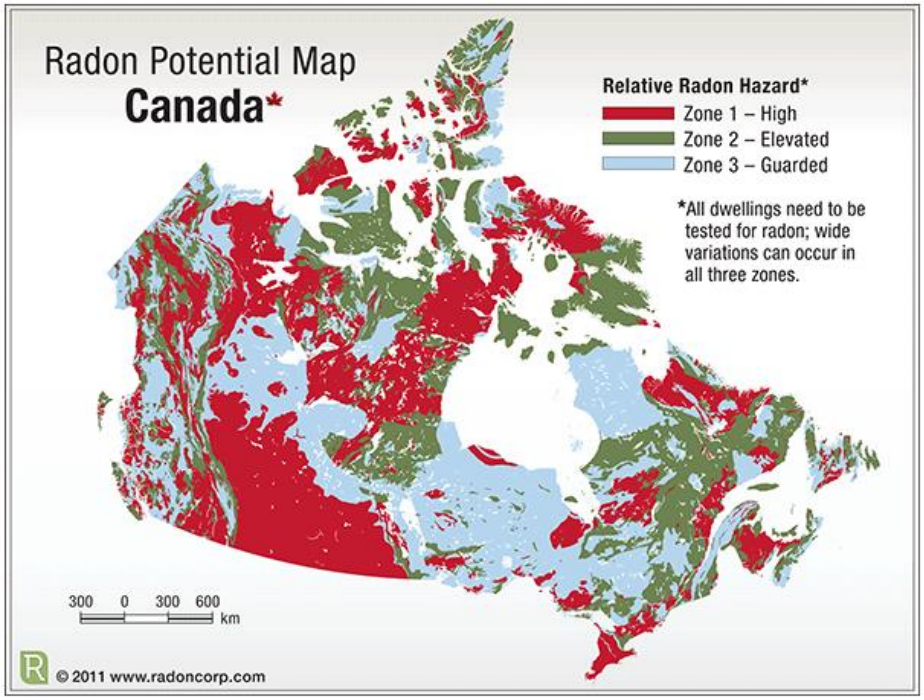
Assessing the Lung Cancer Burden associated with Occupational Radon

- Although radon has been included in some previous occupational, with highly variable results
- UK Study (Brown et al, 2012)
  - 0.6% of lung cancers in both men and women
- Finnish Study (Nurminen et al, 2001)
  - 4.5% of lung cancers in men
  - 1.2% of lung cancers in women
- Canadian Study (OCRC/CAREX) in progress

Radon is Geographically Distributed



Residential testing, Health Canada, by health region



Radon potential, from underlying geology

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Beyond Geography: Variables affecting workplace and offices

- Ventilation!
- Human Activity can make an enormous difference
  - Doors and windows open/closed
- Location in Building
  - Ground floor versus upper offices
- Type and quality of building foundation
- Building design- energy efficiency not necessarily good
- Other: Water use patterns? Water heating?

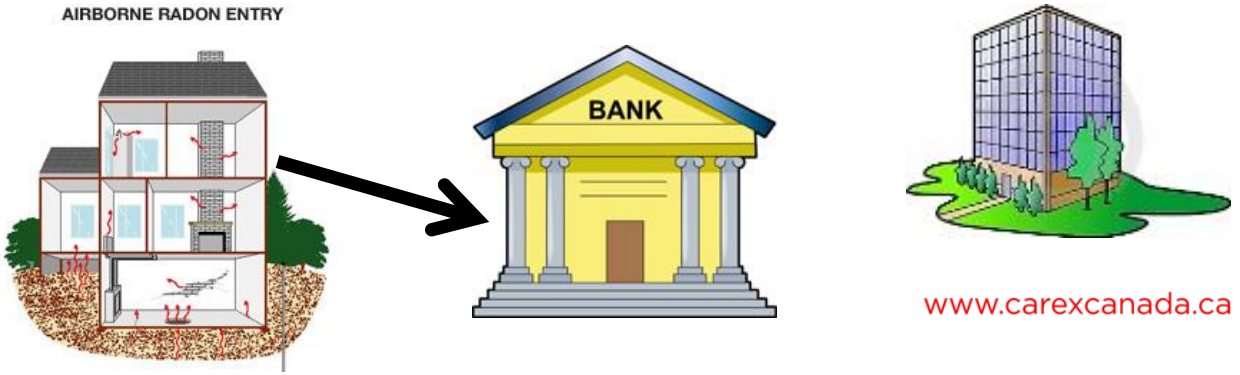
CAREX Proposed Radon Method for Estimating Exposure

For occupations and industries where radon is a recognized risk, use measures from literature, taking into account background levels from residential surveys

- Underground workers
  - Tunnels
  - Transportation
  - Excavation
- Water-related
  - Water treatment
  - Hatcheries
  - Spas, recreation

CAREX Proposed Radon Method for Estimating Exposure

- Residential Extrapolation for low level exposures
- Where **location** is the main driver of exposure, use a proportion of the residential results to generate estimate
- Example: Use second floor housing levels to estimate ground floor radon measures (Field 2012)
  - Variation due to ventilation/Human activity patterns
- Higher floors= negligible?



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www.carexcanada.ca

Some References on Exposure in Canada

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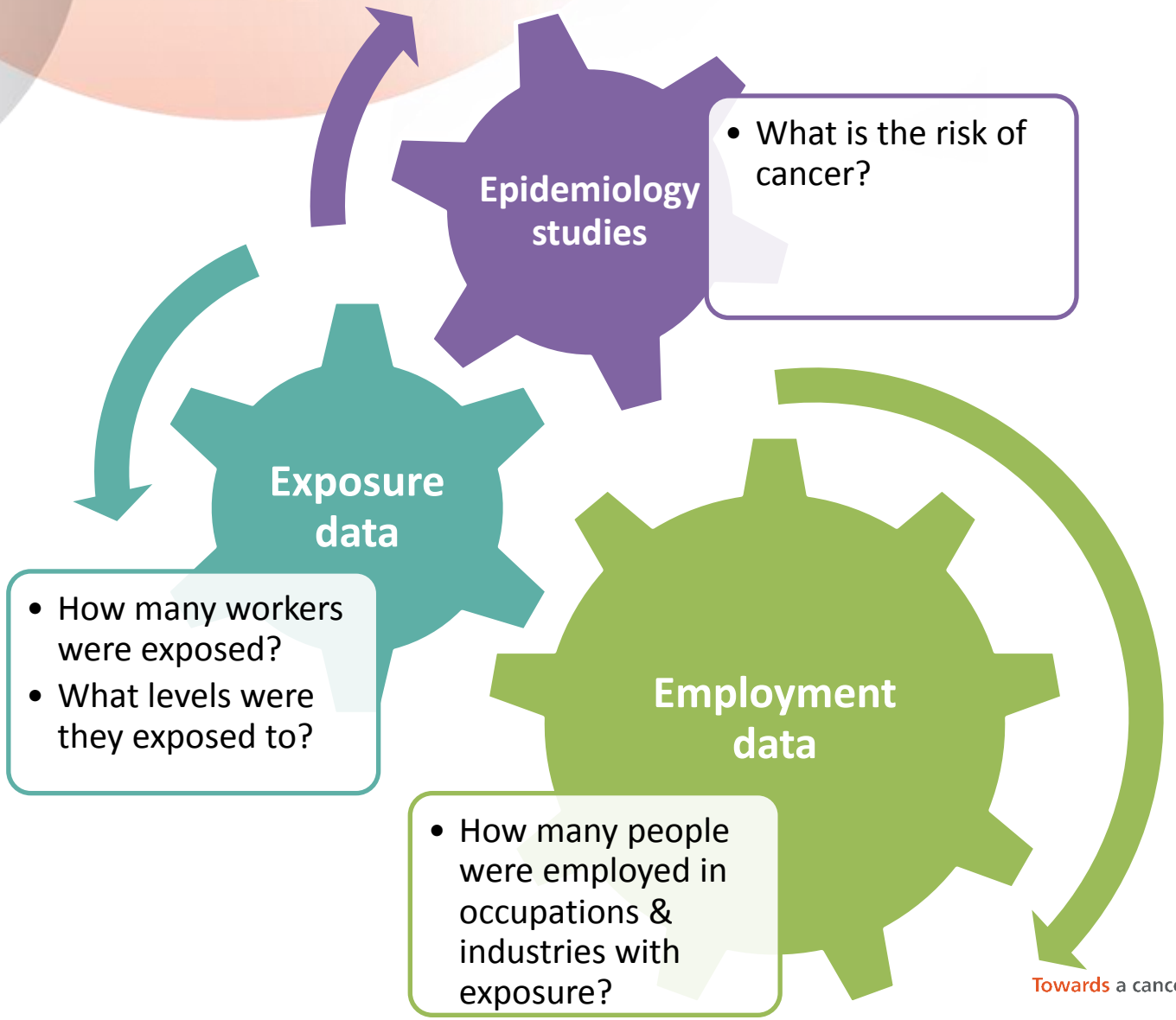
Data needed to estimate burden



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