Radon

Photo : The Lung Association of Saskatchewan

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> **There is no known threshold below which radon exposure carries no risk.**

Radon is a naturally occurring odourless, colourless radioactive gas that is produced from the breakdown of uranium in the soil underneath our homes and workplaces. It is a known human carcinogen. Dr. Aaron Goodarzi[1] of the University of Calgary notes that "Radon = DNA damage = Cancer." Once inhaled, radon can precipitate as solid radioactive polonium, bismuth and lead, which are permanently trapped within the lungs. The World Health Organization's (WHO) International Agency for Research on Cancer (IARC) classifies radon as a Group 1 Carcinogenic to Humans — in the same category with asbestos, benzene, and mustard gas.

Radon is most harmful when it is inhaled in high concentrations over a long period of time. Buildings that are not radon-proofed have the potential to trap

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higher concentrations of the gas. The WHO states that "there is no known threshold below which radon exposure carries no risk."[2]

Radon levels in soil can vary between different parts of the country. It is important for your workplace to have testing done to see what the levels are in your area. Newly emerging data also indicates that different building practices (be they for homes or workplaces) also can strongly influence indoor air radon levels, and so geographic location does not necessarily mean danger or safety when it comes to radon. The only way to be sure is to test. Your Joint Health and Safety Committee (JHSC) can put this on their inspection list and bring to the employer a recommendation to test radon levels at your institution.

Wherever buildings touch soil and there are gaps or cracks, radon can enter. As it cannot be seen or smelled, there is no real way to know if you have concentrations of radon in your workplace or home without testing. The engineering characteristics of the building rather than its age is the contributing factor for radon to be present.

The workplace health and safety committee should ensure that there is a hazard assessment for radon with a plan for prevention and remediation.

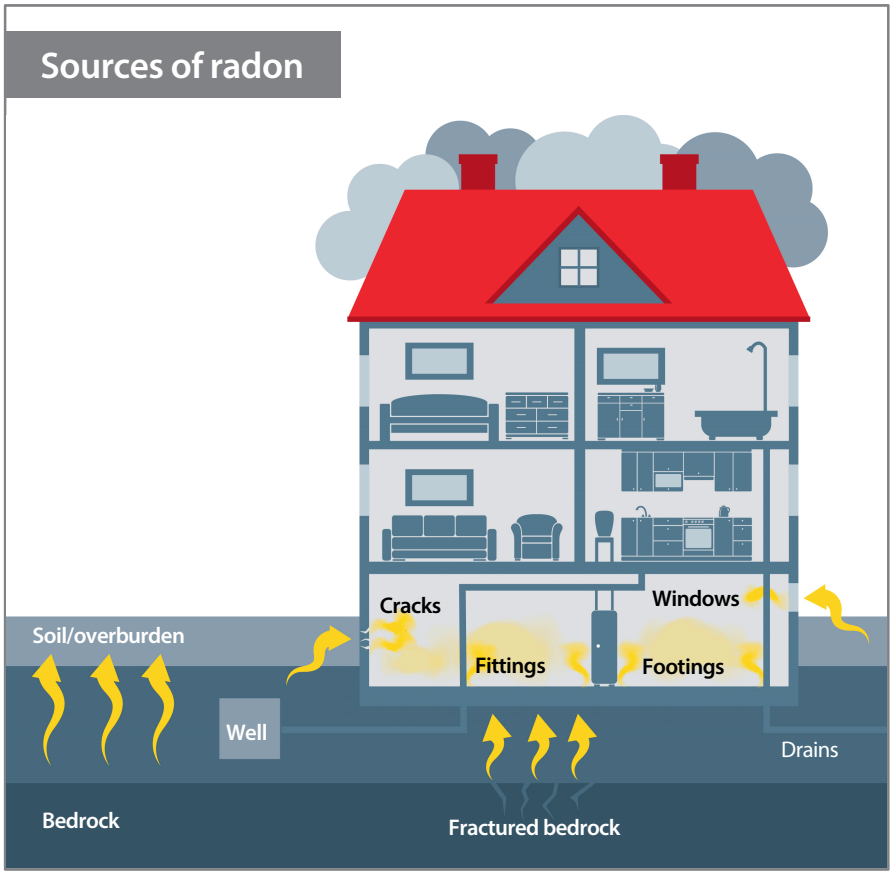

Photo: CAREX Canada

Radon use

CAREX Canada notes that radon was once used for the treatment of ulcers, allergies, arthritis and tumours, and it continues to be used today as therapy for pain relief from rheumatoid arthritis in some European countries.

Researchers use it in small quantities to initiate and influence chemical reactions.

Entry points

Radon enters a building when the air pressure in the building is less than the underlying soil.[3] Examples of entry points are:

- cracks in foundations and floors
- construction joints
- support posts
- window casements
- floor drains
- sump pumps
- spaces inside walls
- dirt floors

Radon & drinking water

Drinking-water from springs and wells normally has higher concentrations of radon than water from reservoirs, lakes or rivers.

Current epidemiological studies have not found a link between drinking-water containing radon and an increased risk of stomach cancer. A higher dose is received by inhaling radon than ingesting it.

WHO recommends that levels for radon in drinking-water are based on national reference levels for radon in air. Aeration or granular activated carbon filters are effective tools to reduce radon concentrations in drinking-water.

Inspections should assess whether radon is present and/or causing exposure over current acceptable limits.

Health effects

Radon enters the body through inhalation where radioactive particles become lodged in lung tissue.

The World Health Organization (WHO) notes that: "Globally, 19% of all cancers are attributable to the environment, including work setting resulting in 1.3 million deaths each year."[4] WHO includes radon as one of those causes.

The development of air-tight buildings – at the workplace and in the home – and seasonal changes where windows and doors are kept closed contribute to higher concentrations of radon. These higher concentrations can lead to the development of lung cancer. Radon ranks highest among five carcinogens with the highest "lifetime excess cancer risk" in Canada.[5]

According to Health Canada, "[l]ong-term exposure to radon is the 2nd leading cause of lung cancer after smoking and the leading cause of lung cancer for people who have never smoked."[6] Health Canada notes that about 16% of lung cancer deaths are attributable to radon, or an estimated 3,300 deaths per annum by CAREX Canada. Smokers are estimated to be 25 times more at risk from radon than non-smokers.

Exposure

Health Canada's provisions for exposure to radon can be found under 4.2.3 (NORM Management for Radon) in the *Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials* (NORM):

Where the estimated annual average concentration of radon gas in an occupied area is more than 200 Bq/m^3 but less than 800 Bq/m^3, the NORM Classification is NORM Management. Steps to reduce this exposure should be taken and include:

- introduction of public and incidentally exposed worker access controls;
- changes in work practices; and
- reducing the radon concentration levels to below 200 Bq/m^3.

The work site should be reviewed periodically to verify that conditions have not changed.

These guidelines address occupational exposures to workers, incidentally exposed workers, and members of the public. They outline protection programs, rights to information, requirements for type of dosimetry equipment to be used,

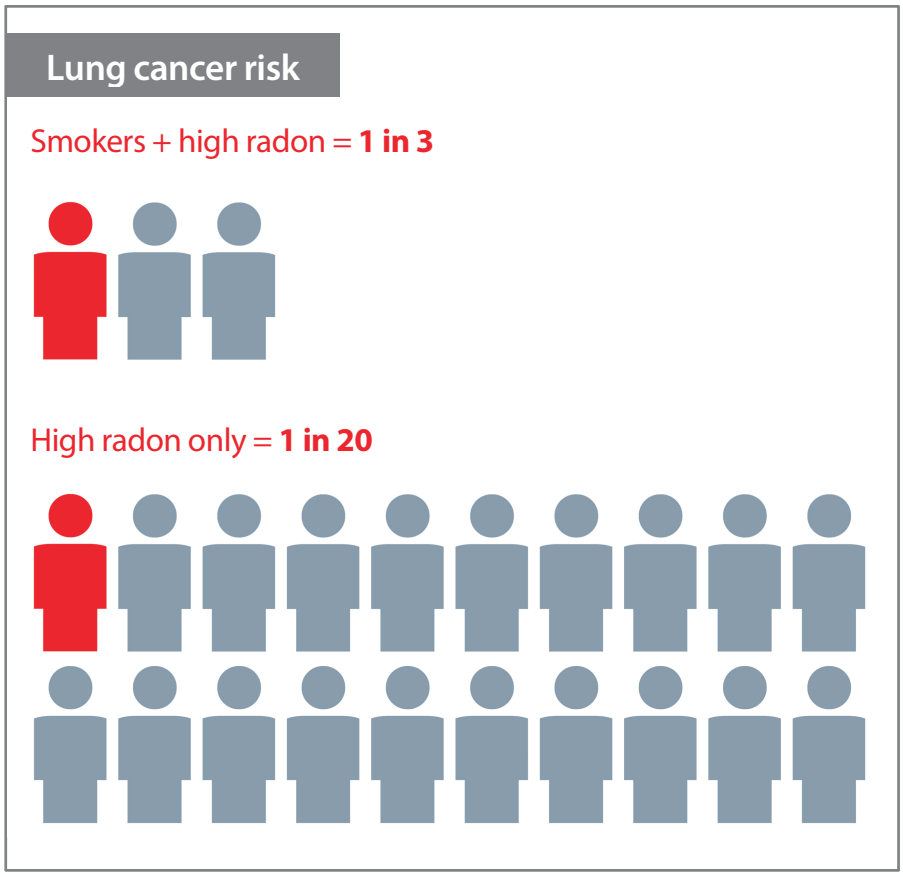

Photo: Health Canada

protection of pregnant workers, what to do when doses are exceeded, return to work protocols, labelling and signs, and requirement for employer to keep records.

A newly published study in the Canadian Medical Association Journal Open[7] by Canada Research Chair Dr. Aaron Goodarzi at the University of Calgary indicates that modern building engineering is inadvertently contributing to exposure of radon in newer residential homes. Larger concrete foundations, increasing air-tightness of the home, and increasing home height (which enables homes to more powerfully draw radon up from the ground) can allow radon to become trapped and accumulate which increases exposure levels and potential increased health risks.

Remediation

Inspections of the workplace or the home should assess whether radon is present and/or causing exposure over current acceptable limits. A plan for remediation can include:

- appropriate testing in the workplace or at home (*Protect Yourself and Your Family*, Health Canada);
- increasing basement ventilation;
- installing a sub-slab depressurization system to reduce household radon;
- sealing gaps between basement floors and walls
- ensuring proper balance between air intake and air efflux in a home (if air intake is less than efflux, then the home will 'suck' more on the foundations, bringing in more radon).

Prevention

Prevention begins with having the lowest exposure levels possible. WHO recommends a reference level of no more than 100 Bequerels per cubic metre (Bq/m^3) – half of Canada's reference level of 200 Bequerels per cubic metre. According to the Canadian Environmental Law Association (CELA)[8], provincial and territorial building codes should be updated to meet the National Building Code (NBC) for better exposure control and to ensure that NORM Guidelines apply to all workplaces.

Ventilation is a necessary component to exposure control. It should meet or exceed building code requirements.

Testing should be done in winter when sealed buildings will show accurate concentrations of radon.

Those working and studying in elementary and secondary schools are among the most exposed to radon, and yet many schools are not tested.

For their investigation, *Radon in schools: A summary of testing efforts across Canada*, CAREX Canada researchers contacted Ministries of Education, school boards, unions, and radon professionals to identify where radon testing had taken place. They did not collect or assess remediation efforts.

Some of the key findings are:

- Quebec is the only province with mandatory testing for radon in schools
- British Columbia, Alberta, Ontario and Manitoba have low rates of school testing
- Some school districts and individual schools have undertaken testing in the absence of province-wide testing requirements.

Toolkit

Naturally Occurring Radioactive Materials (NORM) Guidelines
http://nuclearsafety.gc.ca/eng/resources/fact-sheets/naturally-occurring-radioactive-material.cfm

WHO Guidelines for Drinking Water Quality 2011
http://www.who.int/water_sanitation_health/publications/gdwq3/en/

Radon in schools: A summary of testing efforts across Canada
https://www.carexcanada.ca/en/announcements/radon_in_schools/

CAREX www.carexcanada.ca

Notes

1. Dr. Aaron Goodarzi, University of Calgary, A.goodarzi@ucalgary.ca
2. WHO Radon and Health Fact Sheet No. 291
3. CAREX Canada - Radon www.carexcanada.ca/en/radon/
4. WHO Environmental and Occupational Cancers Fact Sheet No. 350 March 2011
5. CAREX Canada - A Radon Policy Challenge October 2015
6. Health Canada - Radon Reduction Guide of Canadians www.hc-sc.gc.ca
7. Comprehensive survey of household radon gas levels and risk factors in southern Alberta, March 29, 2017 http://cmajopen.ca/content/5/1/E255.full
8. Canadian Environmental Law Association www.cel.ca