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Radon Exposure and Lung Cancer Prevention in Family Medicine: A Narrative Review and Practice Algorithm

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Abstract

Radon is an invisible radioactive gas and an established human lung carcinogen. In clinical care, prevention is often missed because exposure cannot be inferred from symptoms, geography, housing age, or smoking status alone. This narrative clinical review synthesizes international and Canadian guidance, pooled residential radon epidemiology, and recent Canadian exposure data into a practical workflow for clinicians. Evidence was prioritized from carcinogen classifications, World Health Organization guidance, pooled case-control analyses, Health Canada recommendations, and national residential surveillance. The proposed Ask-Test-Act-Document approach advises clinicians to ask about prior testing and lower-level occupancy; recommend long-term testing in the lowest occupied level; interpret results using current Canadian and international reference levels; advise timely mitigation and post-mitigation retesting; and document counselling, test characteristics, results, and follow-up. The review distinguishes prevention from lung-cancer screening eligibility. No individual patient information or human-subject research data are reported. A concise practice algorithm is provided.

Keywords: radon; lung cancer; primary care; family medicine; hospital care; indoor air; environmental exposure; prevention; mitigation; risk communication

1. Introduction

Radon-222 and its decay products are classified by the International Agency for Research on Cancer as carcinogenic to humans [1]. Radon is colourless, odourless, and tasteless; it is produced from the radioactive decay of uranium in rocks and soils, can enter buildings through ground-contact pathways, and can decay into particles that deposit in the airways and damage DNA [2,3]. Pooled individual-level European and North American case-control analyses provide direct evidence that residential radon exposure increases lung-cancer risk, with risk increasing as long-term average indoor radon concentration rises [4,5].

In clinical practice, radon is easy to overlook because it is not detected by history unless clinicians ask about testing, and because a patient may have no tobacco history or obvious occupational exposure. Health Canada identifies long-term exposure to high radon levels as the leading cause of lung cancer in non-smokers, while a Canadian Medical Association Journal practice summary reports that radon is responsible for approximately 16% of lung-cancer deaths in Canada, or more than 3000 deaths annually [6,7]. These figures make radon relevant not only to public health departments and building professionals, but also to clinicians who counsel patients about modifiable risk.

This article provides a practical, literature-based clinical approach for primary and hospital care. The aim is not to prove causation in any individual case, which is rarely possible for a single environmental exposure, but to translate the strongest available evidence into feasible clinical actions: ask, test, act, document, and follow up.

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2. Methods and Scope of the Review

This narrative clinical review was designed for practice translation rather than original epidemiological analysis. Evidence was prioritized in the following order: international carcinogen classifications and public-health guidance; pooled residential radon epidemiology; current Canadian federal guidance on radon measurement, interpretation, and mitigation; recent Canadian aggregate exposure data; and peer-reviewed Canadian studies relevant to primary-care risk communication. Sources were identified from PubMed, Health Canada, the World Health Organization, the International Agency for Research on Cancer, and recent Canadian radon surveillance resources. The search was updated on 30 April 2026.

No private clinical records, patient images, patient quotations, local audit data, quality-improvement data, or individual-level human-subject data were used. The brief practice scenario below is an illustrative composite created only to introduce the clinical problem. It is not a report of an identifiable patient.

3. Clinical Scenario

A primary-care clinician learns during a preventive-care visit that a patient works most days in a finished basement home office and has never tested the home for radon. The patient has never smoked and assumes that lung-cancer risk is negligible. This common scenario illustrates why radon counselling belongs in routine care: exposure cannot be sensed, cannot be ruled out by a regional map, and may be influenced by where and how long a person spends time indoors.

4. Why Radon Belongs in Primary and Hospital Care

4.1. Radon Is Common, Invisible, and Modifiable

The 2024 Cross-Canada Survey of Radon Exposure in Residential Buildings, prepared by the Evict Radon National Study team in collaboration with Health Canada, CAREX Canada, and the British Columbia Centre for Disease Control, reports that approximately 17.8% of Canadian residential buildings have radon levels at or above the Canadian guideline of 200 Bq/m3, and that an additional 24.2% are between 100 and 199 Bq/m3 [8]. The report emphasizes that there are no radon-free areas in Canada and that a household cannot know its personal radon level without testing [8].

Recent Canadian research also suggests that exposure risk is not evenly distributed. In a national Scientific Reports study of 42,051 Canadian residential properties, rural, lower-population-density communities had up to 31.2% higher average residential radon levels than urban equivalents [9]. Southern Alberta research has likewise shown meaningful household radon variability and risk factors in a Canadian urban and peri-urban context [10]. These data support a universal testing message: risk factors can help prioritize outreach, but they cannot replace measurement.

4.2. The Clinical Role Is Prevention, Not Retrospective Attribution

For an individual patient with lung cancer, it is generally not possible to state that radon definitively caused the malignancy. Lung cancers caused by radon are not histologically unique, and multiple inherited, environmental, occupational, inflammatory, and stochastic factors may interact over decades. The clinical value of radon history is therefore strongest in prevention, family counselling, documentation of relevant environmental exposure, and mitigation of current or future exposure.

Primary-care clinicians can normalize radon testing as part of environmental health prevention. Hospital clinicians, respirologists, oncologists, internists, discharge teams, and allied health professionals can reinforce the same message when caring for patients with chronic respiratory disease, lung nodules, lung cancer, or family concern about home exposure. The opportunity is practical: radon can be tested, mitigated, and retested.

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5. The Ask-Test-Act-Document Workflow

Table 1. Practical workflow for radon counselling in primary and hospital care.

Step	Clinical action	Precise documentation
Ask	Ask whether the home has ever been tested for radon; whether the patient sleeps, works, exercises, or spends prolonged time in a basement or ground-floor room; and whether major renovations, basement finishing, foundation work, or ventilation changes have occurred since any prior test.	Prior test status; year of test; result if known; level tested; lower-level occupancy; relevant building changes.
Test	Recommend a long-term test in the lowest occupied level where a person spends at least 4 hours per day. Health Canada recommends testing for 3 to 12 months, with a period of no less than 91 days; fall or winter testing is commonly recommended because homes are more closed and radon may accumulate [11].	Device type if known; location; start/end dates; duration; laboratory or provider; whether the test met long-term criteria.
Act	Use current Canadian guidance for action. If the long-term average is above 200 Bq/m3, advise corrective action to reduce the level as much as practicable; the higher the value, the sooner mitigation should occur [12,13]. Discuss certified radon professionals when mitigation is needed [14].	Result in Bq/m3; interpretation; advice given; referral/resource provided; patient preference; planned mitigation timeline.
Document and follow	Record the counselling and plan. After mitigation, advise repeat testing to confirm reduction. Repeat testing should also be considered after major renovations, ventilation changes, or changes in basement occupancy.	Mitigation completed or declined; post-mitigation result; date for follow-up; counselling about persistent but reduced risk.

5.1. Ask: Make Radon Visible in the History

A radon question can be integrated into preventive visits, respiratory reviews, occupational/home-office assessments, prenatal or child-health visits, and chronic disease management. The most efficient opening question is: "Has your home ever been tested for radon?" If the answer is no, the next step is not to estimate risk from a map, postal code, or house age, but to recommend testing. If the answer is yes, clinicians should ask when the test was performed, how long it ran, which level was tested, what the result was, and whether the building has changed since testing.

Lower-level occupancy is clinically relevant because testing should capture the air people breathe. A finished basement bedroom, home office, recreation room, suite, or workshop may be more relevant than the main floor if that is where a person spends substantial time. Clinicians should also ask about other household members because radon mitigation benefits the household, not only the patient in the exam room.

5.2. Test: Prefer Long-Term Measurement over Short-Term Reassurance

Radon varies hour to hour, day to day, and seasonally; therefore, longer tests more accurately estimate average exposure. Health Canada recommends a 3- to 12-month test, not less than 91 days,

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to determine the average annual level in a home [11]. The detector should be placed in the lowest level of the home where someone spends at least 4 hours per day, and clinicians should avoid giving false reassurance from a short, non-standard, or poorly placed test [11,13].

Clinicians do not need to become building scientists to make an effective recommendation. A practical message is: "Use a recognized long-term radon test, place it where your household actually spends time on the lowest occupied level, send it for analysis as directed, and keep the result."

5.3. Act: Interpret the Number and Reduce Exposure

Table 2. Interpreting long-term radon results for patient counselling.

Long-term result	Clinical interpretation	Counselling message
Less than 100 Bq/m3	Below the WHO recommended reference level and below the Canadian action guideline. Risk is lower, but radon is not considered completely risk-free [3,8].	Document the result. Consider retesting after major structural or ventilation changes or if occupancy of lower levels changes substantially.
100-199 Bq/m3	Below the Canadian guideline but at or above the WHO recommended reference level of 100 Bq/m3 [3,8].	Discuss that further reduction may be reasonable if feasible, especially with substantial lower-level occupancy or strong patient preference. Document shared decision-making.
200 Bq/m3 or higher	At or above the Canadian guideline. Health Canada recommends corrective action above 200 Bq/m3 and reducing levels as much as practicable [12,13].	Recommend mitigation and post-mitigation testing. Higher levels should prompt earlier action. Consider a C-NRPP-certified professional for mitigation [14].

The Canadian action level is 200 Bq/m3, while the World Health Organization recommends a national reference level of 100 Bq/m3 where feasible and states that if 100 Bq/m3 cannot be achieved under country-specific conditions, the selected reference level should not exceed 300 Bq/m3 [3]. These thresholds are policy tools, not biological cut-offs. A patient with 195 Bq/m3 is not biologically different from a patient with 205 Bq/m3; the goal is to reduce cumulative exposure as much as practical, with urgency increasing as the measured concentration rises.

Mitigation is usually a building intervention rather than a medical treatment. Common approaches include sealing entry pathways and active sub-slab or sub-soil depressurization, depending on building design. The clinician's task is to advise action, direct patients to credible resources, encourage certified mitigation where appropriate, and arrange follow-up testing rather than simply recording the initial value.

5.4. Document: Make Prevention Auditable

A radon note should include the result in Bq/m3, test duration, detector location, whether the test met long-term criteria, relevant occupancy pattern, advice given, and follow-up plan. If the patient declines testing or mitigation, document the discussion without judgment. A simple electronic medical record phrase can support consistent practice: "Radon counselling provided; long-term test recommended for lowest occupied level; patient advised to reduce levels if result is above Canadian guideline and to retest after mitigation."

6. Risk Communication

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Radon counselling should be specific, calm, and action-oriented. Avoid implying that every elevated result predicts cancer, or that a low result eliminates risk. A balanced message is: "Radon is common and invisible. The only way to know your level is to test. If the level is elevated, proven building interventions can reduce exposure."

Smoking history remains important because tobacco smoke and radon together increase lung-cancer risk. For patients who smoke or recently quit, radon counselling should be paired with tobacco cessation support. For patients who have never smoked, radon counselling should avoid the misleading reassurance that non-smokers have no lung-cancer risk.

Clinicians should also separate prevention from screening. Radon testing and mitigation are preventive environmental actions. Routine low-dose CT screening solely because of radon exposure is not currently established in Canadian primary-care recommendations; the Canadian Task Force recommendation focuses on adults aged 55 to 74 years with substantial smoking history and recommends against routine low-dose CT screening for other adults, regardless of other risk factors [15]. Patients with symptoms or abnormal imaging need diagnostic assessment, not screening.

7. Implementation Opportunities

Radon counselling can be implemented with minimal workflow burden. Clinics can add one radon question to preventive-care templates, chronic cough/asthma/COPD reviews, and home-office or basement-bedroom assessments. A patient-facing handout can direct patients to Health Canada guidance, long-term test kits, and certified mitigation resources. Hospital teams can include radon testing advice in discharge or survivorship materials for patients and families when appropriate, while avoiding any suggestion that radon can be assigned as the cause of an individual cancer.

The clinical literature has previously emphasized the role of family doctors in radon awareness [16]. The need for an updated practical workflow is strengthened by recent Canadian data showing substantial high-radon prevalence, regional and rural variation, and the continuing reality that household-level risk cannot be known without testing [8,9].

8. Ethical and Regulatory Considerations

This article is a literature-based clinical review and practice algorithm. It does not report a case, case series, patient image, patient quotation, medical record extract, local audit, quality-improvement project, survey, interview, or secondary analysis of private data. The clinical scenario is an illustrative composite used only for education. On that basis, institutional ethics review is not applicable. If authors later add details from an actual patient, written consent for publication and journal-specific case-report requirements should be addressed before submission.

9. Conclusions

Radon exposure is a common, invisible, and modifiable lung-cancer risk that is well suited to primary-care prevention and hospital-to-community counselling. Clinicians do not need to estimate geological risk or prove individual causation. They need a reproducible workflow: ask whether the home has been tested; recommend long-term testing in the lowest occupied level; interpret the result using current guidance; advise mitigation and retesting when indicated; and document the discussion. A concise Ask-Test-Act-Document approach can make radon counselling practical, auditable, and patient-centred.

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Abbreviations

Bq/m3, becquerels per cubic meter; C-NRPP, Canadian-National Radon Proficiency Program; CT, computed tomography; LDCT, low-dose computed tomography; WHO, World Health Organization.

References

1. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Radiation. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, No. 100D; International Agency for Research on Cancer: Lyon, France, 2012. Available online: https://www.ncbi.nlm.nih.gov/books/n/iarcmono100d/ (accessed on 30 April 2026).
2. World Health Organization. Radon. Available online: https://www.who.int/news-room/fact-sheets/detail/radon-and-health (accessed on 30 April 2026).
3. World Health Organization. WHO Handbook on Indoor Radon: A Public Health Perspective; Zeeb, H., Shannoun, F., Eds.; World Health Organization: Geneva, Switzerland, 2009; ISBN 978-92-4-154767-3. Available online: https://www.who.int/publications/i/item/9789241547673 (accessed on 30 April 2026).
4. Darby, S.; Hill, D.; Auvinen, A.; Barros-Dios, J.M.; Baysson, H.; Bochicchio, F.; Deo, H.; Falk, R.; Forastiere, F.; Hakama, M.; et al. Radon in homes and risk of lung cancer: Collaborative analysis of individual data from 13 European case-control studies. BMJ 2005, 330, 223. https://doi.org/10.1136/bmj.38308.477650.63.
5. Krewski, D.; Lubin, J.H.; Zielinski, J.M.; Alavanja, M.; Catalan, V.S.; Field, R.W.; Klotz, J.B.; Létourneau, E.G.; Lynch, C.F.; Lyon, J.I.; et al. Residential radon and risk of lung cancer: A combined analysis of 7 North American case-control studies. Epidemiology 2005, 16, 137-145. https://doi.org/10.1097/01.ede.0000152522.80261.e3.
6. Health Canada. Radon Causes Lung Cancer. Published October 2025. Available online: https://www.canada.ca/en/health-canada/services/publications/health-risks-safety/radon-gas-causes-lung-cancer.html (accessed on 30 April 2026).
7. Mema, S.C.; Baytalan, G. Radon and lung cancer risk. CMAJ 2023, 195, E850. https://doi.org/10.1503/cmaj.230110.
8. Cross-Canada Radon Survey Working Group. Cross-Canada Survey of Radon Exposure in Residential Buildings of Urban and Rural Communities; Evict Radon National Study, Health Canada, CAREX Canada, and British Columbia Centre for Disease Control: Canada, 2024. Available online: https://crosscanadaradon.ca/survey/ (accessed on 30 April 2026).
9. Khan, S.M.; Pearson, D.D.; Eldridge, E.L.; Morais, T.A.; Ahanonu, M.I.C.; Ryan, M.C.; Taron, J.M.; et al. Rural communities experience higher radon exposure versus urban areas, potentially due to drilled groundwater well annuli acting as unintended radon gas migration conduits. Sci. Rep. 2024, 14, 3640. https://doi.org/10.1038/s41598-024-53458-6.
10. Stanley, F.K.T.; Zarezadeh, S.; Dumais, C.D.; Dumais, K.; MacQueen, R.; Clement, F.; Goodarzi, A.A. Comprehensive survey of household radon gas levels and risk factors in southern Alberta. CMAJ Open 2017, 5, E255-E264. https://doi.org/10.9778/cmajo.20160142.
11. Health Canada. Guide for Radon Measurements in Homes. Available online: https://www.canada.ca/en/health-canada/services/publications/health-risks-safety/guide-radon-measurements-residential-dwellings.html (accessed on 30 April 2026).

 doi:10.20944/preprints202606.0017.v1

12. Health Canada. Government of Canada Radon Guideline. Updated 24 September 2025. Available online: https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/radon/government-canada-radon-guideline.html (accessed on 30 April 2026).
13. Health Canada. Radon - Reduction Guide for Canadians. Available online: https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/radiation/radon-reduction-guide-canadians-health-canada.html (accessed on 30 April 2026).
14. Canadian-National Radon Proficiency Program. Find a Radon Professional. Available online: https://c-nrpp.ca/find-a-professional/ (accessed on 30 April 2026).
15. Canadian Task Force on Preventive Health Care. Recommendations on screening for lung cancer. CMAJ 2016, 188, 425-432. https://doi.org/10.1503/cmaj.151421.
16. Garcia-Rodriguez, J.A. Radon gas-the hidden killer: What is the role of family doctors? Can. Fam. Physician 2018, 64, 496-501.