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Summary

Radon gas is a naturally occurring invisible and odourless radioactive gas resulting from the breakdown of uranium in rock and soil. While often diluted in air, it can accumulate inside homes and other buildings and cause lung cancer. In Canada, radon exposure is the leading cause of lung cancer after smoking, and accounts for an estimated 16% of lung cancer deaths. New research is showing many cities in British Columbia, especially in the Interior, have a high percentage of homes where radon levels are over Canada's National Radon Guideline of 200 Bq/m^3.

We believe there are many steps that BC's health agencies and authorities can do to protect people from radon. Health authorities are well positioned to provide education and awareness and speak to diverse audiences such as municipal governments. There are powers to help renters, test schools, and mandate testing and mitigation for daycares. We also think there are important studies to be done on the environmental burden of radon and the cost-effectiveness of interventions. Health agencies and authorities can begin the process of planning for how radon can be addressed in areas under their jurisdiction, and at diverse municipal and provincial levels.

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About our program. The BC Lung Foundation's Healthy Indoor Environments program is focused on providing education, resources, and policy options for addressing priority indoor air pollutants in British Columbia. Canadians spend 90% of their day indoors, with about 70% at home and 20% at work or school. The air we breathe indoors can contain particulates, gases, allergens and fumes that can significantly affect our health in both the short and long term. Knowing the main indoor air pollutants, their sources, and how to reduce them are key to reducing harm to our health. Radon has been identified as the leading environmental carcinogen in Canada. For more information visit our website at https://bclung.ca/programs-initiatives/healthy-indoor-environments-program

1. Taking Radon Seriously

Radon gas is a naturally occurring invisible and odourless radioactive gas resulting from the breakdown of uranium in rock and soil. When radon is released from the ground and into outdoor spaces, it is diluted and is not dangerous. However, radon can seep into homes and other buildings and reach dangerous levels.[1] In Canada, radon exposure is the leading cause of lung cancer after smoking, and accounts for an estimated 16% of lung cancer deaths.[2]

Health Canada has set a National Radon Guideline of 200 Bq/m^3 which applies to homes and other regularly occupied spaces.[3] An estimated 7% of homes in Canada have radon levels above 200 Bq/m^3 but results vary by region with many community health service areas in BC having over 20% of homes tested being over the Guideline.[4] Exposure to elevated radon can be easily avoided. Testing is relatively inexpensive: Small long-term test kits can be purchased, shipped, and posted to labs for analysis for under 50 dollars. Radon mitigation professionals typically charge between $ 2,500-3,000 for installing radon reduction systems into existing houses, and the costs are much less when worked into initial building design and construction for new buildings.[5] Radon mitigation methods are very effective and commonly reduce radon levels by 80-90%, even where pre-mitigation radon levels exceeded 1,000 Bq/m^3.[6]

To date public awareness remains low, with a vast majority of British Columbian households (92%) having not tested for radon and most people being unable to correctly describe radon.[7] As well, law and policy in BC has been slow to respond to the problem. To date the Building Standards Branch has made changes to the *BC Building Code* that apply in some communities known to have a problem,[8] Shared Services BC—the agency that looks after government buildings—has a radon testing program, and one health authority—Interior Health-- has required radon testing in childcares.[9] There is also guidance for realtors to consider elevated radon levels as a latent defect in a home.[10]

We believe the province and municipalities with elevated radon risk should have a clear Radon Plan, following international best practices as developed in the United Kingdom, the European Union, and elsewhere. Reducing radon in homes and workplaces is a way to save lives, and economists have shown that in higher radon areas, testing and fixing homes is a cheaper health intervention than many drugs and surgeries for which our medical system routinely pays.[11] Clear rules covering indoor spaces are needed, and government support can help ensure renters, workers, and low-income individuals are given a helping hand—important elements of ensuring health equity.

Health agencies and authorities can clearly promote education and awareness on radon and lend support to initiatives that come from civil society, non-profit organizations or different orders of government. In this Briefing Note, we outline some further steps that health agencies and authorities can take to increase education and awareness, enact policy change, and promote radon planning.

2. Community Testing and Mapping

The federal governments' Cross-Canada Survey of Radon Concentrations in Homes (2012) was an important start in learning radon levels.[12] however, with an average of 100 radon readings per Health Service Delivery Area, the sample size was too small. To improve the situation, there has been further testing projects. BC Lung ran the RadonAware project in Castlegar and Prince George in 2014, and has subsequently sold test kits, coupled with obtaining consent of participants to hold results in a database. Other organizations, such as the Donna Schmidt Lung Cancer Memorial Society, Take Action on Radon—a national radon awareness program-- and Dr. Anne-Marie Nicol's citizen science projects at Simon Fraser University have also created results.

In the Spring of 2021, the British Columbia Radon Data Repository at the British Columbia Centre for Disease Control began to have a compilation of known radon test results from across BC. It now has an excellent radon map. However, the results show that there are few too few readings in many communities. BC Lung has a short-term project, Radon Community Testing: BC Municipalities and Regional Districts, which is funded by the Real Estate Foundation and Vancouver Foundation. The aim here is not simply to increase public awareness of the need to test but also to get good sample sizes to help community members know local radon risks. We think it is important for many people to know radon risks—not just home occupants, but builders, realtors, municipal building inspectors, employers, landlords, and others whose role is to ensure good health and safety in the built environment. In creating this project, BC Lung drew on studies by Ontario health units, including Thunder Bay District Health Unit,[13] Kingston, Frontenac and Lennox & Addington Public Health[14] Windsor-Essex Health Unit[15] and York Region Public Health.[16]

Our hope is that health authorities (or other government entities) might take over and continue this work. Health agencies and authorities (and, municipalities) can ensure good sample sizes for all communities across BC. Ways to increase numbers of radon tests include free distribution or subsidy or even reducing costs to consumers through bulk buying and offering drop boxes for collection. An important first step health agencies and authorities can take is to test their own buildings, ensure the results are open and transparent to employees and put them into publicly accessible databases, such as the British Columbia Radon Data Repository.

3. Better, Locally Relevant, Radon Studies

Health agencies and authorities in BC could further highlight the burden and social costs of radon. For instance, Public Health Ontario undertook specific studies on the Environmental Burden of Cancer which showed that radon was one of the most significant causes of cancer in the province.[17] This was accompanied by an academic article, "Lung cancer risk of radon in Ontario, Canada: how many lung cancers can we prevent?",[18] and production of accessible materials.[19] We think these health studies were a key step that led Public Health Ontario to include radon education and awareness into the Public Health Standards, the guiding documents for local health authorities in the province.[20]

We also emphasize the importance of cost-effectiveness analyses. Cost effectiveness analysis seeks to estimate the cost of a drug, technology, program, or intervention in terms of expected results. Typically, a Quality-Adjusted Life Year (QALY) is used as the expected benefit so that the cost effectiveness represents not only how long lives are extended, but also the health, or quality of experience, of the persons whose lives are extended by the intervention. Health systems will typically use threshold figures of $50,000 Canadian dollars (for the United Kingdom) and $65,000 Canadian dollars (for the United States) per QALY.[21]

Radon testing and mitigation has been found to be a cost effective intervention for many countries.[22] This suggests radon prevention makes as good health-economic sense —even when paid for by the public medical system—as many surgeries and drugs that are now covered. Recent Canadian research shows testing and retrofitting of older homes is cost-effective in Canadian cities with elevated radon risk.[23] This research showed that testing and mitigation were cost-effective interventions in Kelowna, but we still lack analysis for many locations in BC known to have elevated radon levels. This is important work that health agencies and authorities might contribute to and which could pave the way for stronger policies.

4. Radon as a Health Hazard

Health officers are familiar with British Columbia's *Public Health Act* and accustomed to interpreting it. That said, many provisions of *the Public Health Act* have never gone before BC courts. When it comes to radon, we think there is some room for novel interpretation.

The *Public Health Act* empowers public health officers to do various things to stop "health hazards". This includes inspecting places to see if health hazards exist[24] and making orders to prevent health hazards.[25] This might point to wide ranging interventions by health officers concerning radon, such as inspecting and issuing orders in rental accommodation. However, radon is not listed as 'prescribed health hazard' in the *Health Hazards Regulation.* Health officers have told us they are reluctant to treat radon as a health hazard or to inspect or issue orders in private residences. We think a good argument can be made for treating radon as a health hazard.

. The *Public Health Act*, at section 1, provides a very general definitions of "health hazard" as "a condition, a thing or an activity that endangers, or is likely to endanger, public health." We found no cases in BC that indicate the scope of this general provision. This suggests a broad interpretation is possible. Much turns on what counts as 'public health'. Here again, however, there is not much case law in Canada regarding what 'public health' characterizes. One decision—from 2001 --by the Ontario Information and Privacy Commissioner ruled that air quality and other environmental concerns fall within public health.[26] In the Ontario case of *Jorgensen v. Halton (Regional Municipality),* 2000, the Ontario Health Services Appeal and Review Board found that indoor air quality issues in a daycare (odour, water staining, and mould growth) amounted to health hazards, and upheld inspectors' orders to test and remediate. [27] A broader notion of public health might also be drawn from sections of BC's *Public Health Act* which provide for public health plans that "promote and protect health and well-being". [28]

More generally, in recent decades public health practitioners have shifted away from an idea of public health as only being concerned with infectious diseases or imminent threats. More current definitions, such as by the World Health Organization, state that public health is "the art and science of preventing disease, prolonging life and promoting health through the organized efforts of society."[29] Public health focuses on the entire spectrum of health and wellbeing, not only the eradication of diseases. Many activities are targeted at populations such as health campaigns. This broader approach is at times described as the "new public health" and as something that "we, as a society, do collectively." Public health addresses the "conditions to be healthy" meaning that it is focused on "the prevention of disease and the promotion of health", as opposed to

medical care for those who are already ill.[30] These wider approaches focused on disease prevention support public health interventions concerning radon in the home.

There are important precedents elsewhere we can also draw on. Alberta Health Services, which has ordered radon mitigation and developed a guidance document on radon in rental accommodation. Inspectors drew on general nuisance clauses in Alberta's *Public Health Act* to inspect rental accommodation for radon and to speak to landlords.[31] We think there are enough similarities between Alberta and BC's legislation to allow health officials in BC to take similar steps. [32]

5. Daycares

Daycares are a particular concern in preventing radon exposure. Radon has a disproportionate effect on young children due to their fast breathing, little lungs, and rapidly dividing cells.[33] 58% of children under the age of 6 participate in some form of child-care in British Columbia.[34] The World Health Organization has emphasized the importance of radon control in childcare settings.[35]

Health authorities have the power to make radon testing a licensing requirement under the *Community Care and Assisted Living Act,* and the Child Care Licensing Regulation. The *Act* states that a licensee must operate the community care facility in a manner that will promote the health, safety, and dignity of persons in care.[36] The Regulation states that a licensee must ensure that a healthy and safe environment is provided at all times while children are under the supervision of employees",[37] and that children do not have access to any object or substance that may be hazardous to the health or safety of a child.[38] The *Community Care and Assisted Living Act* empowers medical health officers to attach terms and conditions to a license,[39] and to revoke licenses if there is a risk to persons in the care of such facilities.[40]

The Interior Health Authority now stands out in BC for using these powers. In 2014 Interior Health embarked on a radon campaign which included, educational materials and mailing free test kits. By 2017 this was turned into a mandatory requirement to test for radon as a condition of licensing.[41]

The Ministry of Health also has important powers that could shape the radon issue for daycares. The Ministry has already issued fact sheets on other important health issues for daycares: For lead in drinking water, these stress that lead levels can violate the Child Care Licensing Regulation.[42] As well the Director of Licensing has the power to specify policies and standards of practice for all community care facilities.[43] This was done during the COVID-19 pandemic.[44] The Ministry of Health could issue fact sheets and/or practice standards around radon. The Director of Licensing could order Health Authorities to make investigations and reports about radon in daycares in their geographic areas.[45]

6. Schools

The *School Act* provides that regional health boards must designate a "school medical officer" for each school district.[46] School medical officers are also health officers within the meaning of BC's *Public Health Act*.[47] School medical officers thus have the general powers of inspection provided for in the *Public Health Act* such as to enter places to perform inspections for the purposes of determining whether a health hazard exists or likely exists. As we argued above, this extends to ordering radon testing. The *Public Health Act* requires consent or a warrant when inspecting private dwellings. [48] However, this does not apply to schools—giving medical health officers greater power to order inspections of schools.

The *School Act* also provides specific responsibilities for medical health officers in relation to schools. Various duties and powers of medical health officers assume the ability to inspect schools. As one school board states in an administrative procedure manual, the school medical officer "is responsible for ensuring the district's school buildings do not put the health or safety of students at risk".[49] For instance, *School Act* s. 90 (2) allows a school medical officer to require a board to close a school when he or she considers that the health or safety of students is at risk.[50] They can also examine students' health and if necessary report to the board.[51] A good argument can be made that examining health implies also examining risk factors, such as the presence of radon in schools. There are also provisions requiring health officers to make inspections when requested by the Minister responsible (s. 90(1)).

Vancouver Coastal Health has interpreted ss. 90(1) and 90(2) as supporting a School Inspection Guideline, which includes attention to indoor air quality issues.[52] Northern Health has policies for inspections being routinely done once every two or three years.[53] As well, high level initiatives such as "Healthy Schools BC" do provide performance standards and school assessment tools.[54] These mention the physical environment as well as holistic assessments of eating, social relationships, active living and healthy practices.

Once it is known that a school has elevated radon, medical health officers can invoke provisions of the *Public Health Act* pertaining to hazards. School districts also have duties to act, stemming both from general duties to protect students' health, and from the Occupational Health and Safety Regulation (BC Reg 296/97) provisions on ionizing radiation. BC Lung further sets this out in its research on Radon in Schools.

7. Radon Planning

British Columbia's provincial government and local governments in high radon regions need Radon Action Plans. While many countries such as the United Kingdom and members of the European Union have such plans, Canada's federal system places the safety of indoor spaces squarely in provincial jurisdiction. The action items listed above—from community testing to rules for daycares—are all potential features of such a plan, and will be more effective if rolled out in a coordinated fashion. A Radon Action Plan can work to ensure thorough knowledge of where radon is a problem, set out steps that can be taken to reduce radon exposure, and work with clear goals and timeframes, such as "to eliminate elevated radon in all homes and workplaces in ten years".

Health Canada's National Radon Program has taken important steps to begin testing, set a Radon Guideline, developed standards and protocols for testing and mitigation, and developed a framework for radon professionals, and outline steps that provinces, territories and municipalities can take to address radon.[55] Health agencies and authorities can play an important role in creating action plans at the provincial and local government level. In British Columbia there is already an established process whereby municipalities and health authorities work together on Healthy Built Environments, and radon can be included. If mayors and council know health authorities are taking the issue seriously, they will be more likely to act.

At the provincial level, a full radon plan will require interventions from the Ministry of Health and may ultimately require legislative change beyond the powers of health agencies and authorities—with clearer rules for workplaces, rental accommodation, real estate transactions and tax credits and incentives for testing and mitigation. However, agencies and authorities can make plans covering their own operations and areas under their own jurisdiction, take the initiative to begin planning processes, and take a lead role in coordination between different governments, departments, and stakeholders in society.

BC Lung's Healthy Indoor Environments program would welcome the chance to work with BC's health agencies and authorities.

We think with the right attention and effort, we can shift the situation in BC, and remove elevated radon from our indoor spaces.

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