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Radon Risk Communication Strategies: A Regional Story

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Abstract **Risk communication on the health effects of radon encounters many challenges and requires a variety of risk communication strategies and approaches. The concern over radon exposure and its health effects may vary according to people's level of knowledge and receptivity. Homeowners in radon-prone areas are usually more informed and have greater concern over those not living in radon-prone areas. The latter group is often found to be resistant to testing. In British Columbia as well as many other parts of the country, some homes have been lying outside of the radon-prone areas have radon levels above the Canadian guideline, which is the reason Health Canada recommends that all homes should be tested.**

Over the last five years, the Environment Health Program (EHP) of Health Canada in the British Columbia region has been using a variety of different approaches in their radon risk communications through social media, workshops, webinars, public forums, poster contests, radon distribution maps, public inquiries, tradeshows and conference events, and partnership with different jurisdictions and nongovernmental organizations. The valuable lessons learned from these approaches are discussed in this special report.

Introduction

Risk communication is a shared interest of policy makers and stakeholders. Many agree that communicating risk to the public is a complicated undertaking and it poses formidable challenges (Johnson & Fisher, 2006; Lipkus & Hollands, 1999). One of the key communication challenges with radon has to do with public apathy (Sandman, 1986). Contrary to technological hazards such as radioactive contamination or toxic wastes, public perception of radon risk represents an optimistic bias (Weinstein, Klotz, & Sandman, 1988). Another communication challenge stems from the fact that radon occurs naturally, thus no "villain" exists to blame and not many obvious radon "victims" are observed (Fisher & Johnson, 1990). In fact, any harmful health effects of radon often do not show up for a long time.

Radon exposure occurs primarily in a person's home, and thus it is an individual's responsibility to test and mitigate for radon. The nature of this situation rules out conventional regulatory approaches that are used in managing pollution sources (Desvousges, Smith, & Rink, 1989). For this reason, regulatory bodies turn to information programs as a way of communicating risk and encouraging voluntary reductions in risk (Johnson & Fisher, 2006). The perception of radon as a "low-risk problem" is attributable to multiple factors that include the absence of federal regulations, competing environmental concerns presented daily in the media, concerns about home values, and public apathy (Johnson, Fisher, Smith, & Desvousges, 2010).

The Environmental Health Program (EHP) of Health Canada in the British Columbia region has been using a diverse approach in their communication of radon risks, which includes responses to public inquiries, trade shows and conference events, social media, workshops, webinars, public forums, radon poster contests for students, and radon distribution maps creation. Radon risk communication efforts through EHP has benefited from partnerships with different jurisdictions and nongovernmental organizations, which aid in adding strength and credibility to the message. This special report presents the lessons learned from radon testing in federal buildings as well as education and awareness activities for the public in the British Columbia region. In particular, it presents knowledge of the public's misconceptions of radon risk and the strategies that are used to "demystify" them. The myths identified for discussion here were the result of the experiences in education and awareness activities, as well as through literature reviews and case studies.

Strategies to Demystifying the Radon Myth

Myth 1: Radon should remain low on the scale of concern for the public. Radon does not seem to cause any visible health effects. There are no obvious "dead bodies," and lung cancer caused by radon exposure, if it occurs, will not be for many years (Fisher & Johnson, 1990; Radon Prevention and Mediation [RADPAR], 2011; World Health Organization [WHO], 2009). Such human perceptions present considerable challenges to the design of an effective risk communication strategy in overcoming public apathy towards radon.

Health Canada estimates that indoor radon exposure causes the deaths of approximately 3,200 Canadians every year—16% of all lung cancer deaths (Health Canada, 2012a). Thus, it makes radon the second cause of lung cancer after smoking (Health Canada, 2012b). Radon is the largest source of natural radiation exposure (Canadian Nuclear Safety Commission [CNSC], 2013), as it represents over 30% of the naturally occurring radiation people are exposed to in a lifetime (CNSC, 2011). In addition, one in three people who have had long-term exposure to elevated radon levels and tobacco smoke will be diagnosed with lung cancer (Health Canada, 2012c). Overall, the number of radon-related deaths in Canada from lung cancer is about 25% higher than the number of traffic-related deaths and greatly exceeds the number of deaths due to accidental poisoning and homicides (Statistics Canada, 2009). According to the Canadian Cancer Statistics 2013 report released by the Canadian Cancer Society, the Public Health Agency, and Statistics Canada, British Columbia has 139 cancer deaths per 100,000 population (9,700 deaths in the total population), with the leading cause of cancer death being lung cancer. Thus, with respect to Myth 1, the use of statistical or quantitative information in risk communications is needed to raise public concern over radon exposure and its health risks.

Myth 2: The perception is that indoor radon exposures are natural, therefore, people should have no or little control (RADPAR, 2011). This statement is not correct. While sources of radon are ultimately geological and natural, high indoor radon exposures may not be. Indoor radon levels can be considered artificial (or "technologically enhanced") if they are the consequence of human activities such as building design, construction, and usage (RADPAR, 2011). In addition, indoor radon concentrations can be easily measured; if they are found to be high they can be reduced. Therefore people do have control if they choose to take preventative action.

Elevated levels of radon can be attributable to human activities, particularly when a building has been upgraded with energy efficient measures therefore making it "airtight." In one example, the owners of a 110-year old house in Peachland, British Columbia (a radon-rich area), conducted a six-month radon test in various areas of their home (Paterson, 2012). When the log house was "sealed" for energy conservation and refitted with double-glazed windows, the radon levels were found to increase substantially. In certain areas of the house, levels of the radioactive gas were as high as 2,035 Bq/m^3 (55 picocuries/L). Both the main floor and upper floor were measured to be above 1,000 Bq/m^3 in the winter months. The owners subsequently contracted a radon mitigation specialist to reduce the radon levels in the house.

Elevated radon ingress can be due to the structure of the building as well as the operational activities that take place within it. This was the case at a fish hatchery, in a non-radon-rich area. Various buildings at the site that met Health Canada's testing criteria of occupancy (>4 hours per day) were tested. All buildings tested at the site were found to be below Health Canada's guideline level except the offices right below a water aeration tower, which had radon levels at approximately 1,100 Bq/m^3. The office building with a water aeration tower had a rather unique structure in that the aeration tower was constructed on top of the administration office that was found to have high levels of radon. It was noted that well water from two aquifers was supplied to the aeration tower. The water was then allowed to fall from a height through a series of segmented columns. The purpose of this was to dissipate undesirable gases (such as nitrogen) and add oxygen to the water prior to being used for hatchery purposes. According to a radon report of WorkSafe BC (Copes, 2009), "Land-based fish hatcheries normally use large quantities of water that has come from an underground source. Hatcheries having the aeration tower contained within the building envelope are particularly prone to having the highest radon levels." It has been reported that radon levels in groundwater can generate up to 40 times more radon in indoor air at a commercial fish hatchery (Kitto, Kunz, McNulty, Kuhland, & Covert, 1995).

The aforementioned scenarios reveal how building structures and human activities may contribute to high levels of radon. They enhance our knowledge base through experience, and serve as narrative or qualitative information for risk communication. To demystify Myth 2 in risk communication, it is paramount to underscore that while sources of radon are naturally occurring, high indoor radon exposures can be due to human activities. Thus, the concentration of radon may vary widely from house to house, building to building, and may be contingent upon "the human factor." When it is claimed that radon occurs naturally, the human component that influences exposure to radon should also be mentioned. More importantly the human component that can prevent the risk of radon exposure should be emphasized; it is easy and inexpensive to test and if levels are high they can be reduced by a mitigation specialist.

Myth 3: Testing is expensive and the house value will be affected after mitigation (Fisher & Johnson, 1990). The public has a general perception that radon problems may involve high costs. For example, homeowners will have to buy and use a radon monitor and possibly pay for expensive mitigation. Radon communications intended to motivate testing may not be successful in situations where the homeowner lacks the resources to mitigate any problems that they find (Svenson & Fischoff, 1985). Additionally, concerns over property values may also discourage people from testing or from sharing or disclosing the results of their tests. Desvousges and co-authors (1989) found that nearly half of homeowners surveyed thought that their home would be worth a lot less even if a radon problem were fixed.

To address concerns surrounding Myth 3, risk communication must underscore the fact that testing is not expensive and that mitigation can be comparable to other home maintenance costs such as replacing a furnace or air conditioner. Obtaining a reliable radon protection plan may be a viable option to reduce the cost of mitigation. Effective risk communications must achieve an informed decision that radon risks can be addressed less expensively

than many other health risks (Desvousges et al., 1989). It is important to emphasize that all homes have radon, so a house is not bad or contaminated if it has measurable levels of radon. Homeowners need to know how much radon is in their homes as compared to the Canadian guideline.

Myth 4: Radon distribution maps are reliable sources for measurement- and mitigation-related decision making for individual homeowners. Radon maps can be developed based on indoor radon measurements, geology, aerial activity, soil permeability, and foundation type. While maps can increase understanding, simplify complex concepts quickly, and enable easy comparisons, they are only as good as their intended purpose. Graphical displays and visual communication of risk through a radon map can offer unique benefits for improving overall communications to stakeholders and the public (Lipkus & Hollands, 1999). They may, however, also lead to a false sense of complacency and reluctance to initiate testing. Radon distribution maps are not intended to be used for determining whether a home in a given zone should be tested for radon but rather to help governments, health professionals, and other authorities to target their resources.

According to Health Canada's 2009–2011 Cross Canada Radon Survey and federal building testing program in British Columbia, homes and buildings with elevated levels of radon were found in 13 out of 16 health regions throughout the province. As mentioned previously, radon ingress results from both natural causes and human activities. Therefore, with respect to Myth 4, an important risk communication message is that all homes have some level of radon and therefore need to be tested regardless of geographic location.

Myth 5: A radon risk communication strategy will be equally applicable or effective in all regions. The actual communication strategy chosen in a region will depend on a number of factors such as the extent of the radon problem in that region, the present state of public knowledge about radon, the available budget, the existence of a national radon reference level, and national and provincial building codes. In general, people respond better to risk information that is both quantitative and qualitative than through either one alone. Quantitatively, people need to know the guideline level, the duration of time for mitigation action, and the statistics on radon health effects. Qualitatively, people are inspired by real-life stories of those who have been impacted by radon or have contracted lung cancer from radon and by success stories in bringing radon levels down through mitigation. Thus, effective risk communication needs to involve the use of both qualitative and quantitative information (Smith, Desvousges, & Fisher, 1987). A very popular visual tool that EHP has used in communicating radon risk is the radon model house developed by Health Canada for use in all regions. The model house demonstrates the various entry routes of radon into a home and mitigation measures that can be employed, such as active subslab depressurization units.

The characteristics of homeowners also come into play regarding their concerns over health. Older people tend to be less willing to acquire health risk information, whereas people with existing health concerns are more willing to acquire health risk information. Educating young people could be one approach for helping to disseminate health risk information to other age groups (RADPAR, 2011). With the support of Health Canada, British Columbia's Interior Health Authority conducted two poster contests in 2012 and 2013 targeting junior secondary students in radon-rich areas to raise awareness on radon. In addition, through contracting a nonprofit organization, EHP was able to use popular social media tools (such as Twitter, Facebook, YouTube, etc.) to reach out to a wider audience.

Socioeconomic and ethnic diversity components also influence the risk communication process. For example, the demographics in British Columbia indicate a diverse ethnic population. Cultural and ethnic background may affect people's perceptions about radon risk. Some people may be relatively less receptive to radon risk messages, and thus the process of risk communication cannot be isolated from the broader social and cultural context. This variability poses challenges in terms of managing environmental risks across a culturally heterogeneous society. To engage with different ethnic communities, EHP has exhibited a radon booth at various ethnic community health fairs. Vaughan (1995) underscores the importance of understanding the different patterns of responding to risk situations, and how the communication process evolves within varying sociocultural environments.

It is well recognized that risk communication may enhance public knowledge and encourage informed consent without resulting in behavioral change (Golding, Krimsky, & Plough, 1992). Johnson and co-authors contend that it is a rather naïve assumption that information programs will motivate people voluntarily and rationally to reduce risks (Johnson et al., 2010). Thus, with respect to Myth 5, due to the various factors that influence responses to radon risk communication, it cannot be expected that one radon risk communication strategy will be equally applicable or effective in all regions. Solving the radon problem will require a mix of risk communication, incentives, and regulation (Golding et al., 1992).

Myth 6: Risk communication is a loner's task. The World Health Organization argues that effective risk communication requires cooperation among organizations with good community credibility (WHO, 2009). Health Canada in the British Columbia region is privileged to benefit from partnerships with other federal department(s) and local health authorities to share expert knowledge and support education and awareness on radon through radon public forums. Given the often apathetic response to the health risk of radon exposure, it is very valuable in partnering with relevant stakeholders to increase awareness. Some of Health Canada's roles include the Canadian guideline for radon, producing radon guides and fact sheets, coordinating the federal building-testing program, and assisting radon initiatives by local health authorities. The province of British Columbia (the Building and Safety Standards Branch of the Ministry of Energy, Mines, and Natural Gas) administers the British Columbia Building Code to prevent radon ingress and funds education and awareness initiatives. Local health authorities in radon-rich areas actively promote education and awareness in their areas and provide expertise to coordinate testing in public schools and daycare centers.

EHP is also a member of the provincial radon intergovernment information and liaison group that comprises staff from the British Columbia Centre of Disease Con-

trol (BCCDC), British Columbia Ministry of Health, Canadian Mortgage and Housing Corporation, British Columbia Lung Association (BCLA), Northern Health Authority, Interior Health Authority, and the Provincial Health Services Authority. This group provides a forum for sharing information on radon issues and promoting ideas for increasing awareness and testing. Additionally, an annual radon workshop is held in Vancouver as a result of collaborative efforts of EHP, BCCDC, and BCLA. The target audiences for the radon workshop are health professionals, academia, industry stakeholders (building contractors, home inspectors, etc.), and students. The goal of the workshops has been for participants to understand the current state of knowledge on strategies to reduce residential radon exposure, including challenges and current knowledge gaps. Part of the workshop has been available online to increase the opportunity for people across Canada to participate. Additionally, EHP engages with stakeholders in the building industry such as home inspectors, building contractors, and realtors to make radon-related presentations, to provide information on the national building code to prevent radon ingress, and to raise awareness of the Canadian National Radon Proficiency Program (C-NRPP), which certifies radon professionals (C-NRPP, 2012). Thus, with respect to Myth 6, Health Canada educates and raises awareness on radon measurement and mitigation by partnering with nongovernmental and nonprofit organizations.

Conclusion

A good risk communication strategy should create the basis for behavioral change and provide clear actions for people to take (RADPAR, 2011). After considering the nature of the radon problem, six key myths have been identified and demystified for effective risk communications. The following can be used for the development of a set of core messages aimed at target audiences.

1. Radon is truly a serious health threat; lung cancer development and death can be reduced by controlling an individual's radon exposure.
2. Indoor radon exposures are from natural resources and can be increased or decreased through human activities. The latter message points to the fact that radon risks can be managed.
3. Testing is easy; mitigation is effective and options are available to address mitigation costs.
4. A radon distribution map is only as good as its intended purpose, such as for authorities to target their resources. The only way to know if a radon problem exists is to test, as radon concentrations vary from home to home.
5. An effective risk communication strategy calls for a consideration of the demographic and socioeconomic context of the public, and the use of both quantitative (statistical data) and qualitative communication approaches.
6. Risk communication is a joint effort at the local and national levels. Federal departments, provincial governments, local health authorities, nonprofit organizations, and industry need to collaborate to share knowledge, expertise, resources, and ideas that will encourage testing and mitigation.

Radon risk is a global issue. Some countries may be more advanced in the development of risk communication strategies and programs, while others are lagging behind. The lessons learned and strategies established may serve as valuable references for less developed countries. The ultimate goal of radon risk communication is to reduce the number of lung cancer deaths caused by radon locally and beyond. Additionally, effective risk communication may succeed in persuading policy makers that radon is indeed an important public health issue that requires action (WHO, 2009).

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continued on page 106

References *continued from page 105*

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