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 depending on the audience. 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 who are in non-radon prone areas and are more likely to be willing to measure the radon level in their homes. Those living in areas that are less likely to have high radon levels are often found to be resistant to testing. In British Columbia (BC), as well as many other parts of the country, there have been homes lying outside of the radon-prone areas with 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 B.C. 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 non-government organizations. The valuable lessons learned from these approaches are discussed in this paper.

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.[1] One of the key communication challenges with radon has to do with public apathy.[2] Contrary to technological hazards such as radioactive contamination or toxic wastes, public perception on radon risk represents an optimistic bias.[3] Another communication challenge stems from the fact that radon occurs naturally, thus there is no "villain" to blame and there are not

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[1] *Isaac M. Lipkus and J. G. Hollands. "The Visual Communication of Risk," Journal of the National Cancer Institute Monographs No. 25, 1999, p. 149; F. Reed Johnson and Ann Fisher, Conventional Wisdom on Risk Communication and Evidence from a Field Experiment, Risk Analysis, Vol. 9, No. 2, 1999, p. 213.*

[2] *P. Sandman. Available at: http://www.psandman.com/articles/explain1.htm, accessed June 25, 2013.*

[3] *N. D. Weinstein, M. L. Klotz, and P. M. Sandman, "Optimistic biases in public perceptions of the risk from radon," Am. J. Public Health, 1988 July, 78(7), p. 799.*

many obvious radon "victims".[4] 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.[5] For this reason, regulatory bodies turn to information programs as a way of risk communicating and encouraging voluntary reductions in risk.[6] The perception of radon as a "low-risk problem" is attributable to multiple factors including the absence of federal regulations, competing environmental concerns presented daily in the media, concerns about home values and public apathy.[7]

The Environment Health Program (EHP) of Health Canada in the British Columbia (BC) Region has been using a diverse approach in their communication of radon risks, which includes responses to public inquiries, tradeshows and conference events, social media, workshops, webinars, public forums, poster contests and radon distribution maps. Radon risk communication efforts through the EHP has benefitted from partnerships with different jurisdictions and non-governmental organization, who aid in adding strength and credibility to the message. This paper presents the lessons learned from radon testing in federal buildings, as well as education and awareness (E&A) activities for the public in the BC region. In particular, it presents knowledge of the public's misconceptions of radon risk and the strategies that are used to "demystify" them.

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. Such human perceptions present considerable challenges to the design of an effective risk communication strategy in overcoming public apathy towards radon.

Based on Health Canada's latest survey, indoor radon exposure causes the deaths of approximately 3,200 Canadians every year – 16 per cent of all lung cancer deaths.[8] Thus, it

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[4] Ann Fisher and F. Reed Johnson. "Radon Risk Communication Research: Practical Lessons," J. Air Waste Manage. Assoc., 1990, 40:5, 738-739.

[5] W. H. Desvousges, V.K. Smith, and H.H. Rink III. "Communicating Radon Risk Effectively: Radon Testing in Maryland," EPA-230-03-89-048, Washington, B.C., U.S. Environmental Protection Agency, 1989, p. 177.

[6] F. Reed Johnson and Ann Fisher. "Conventional Wisdom on Risk Communication and Evidence from a Field Experiment," Risk Analysis, Vol. 9, No. 2, 1999, p. 209.

[7] Dominic Golding, Sheldon Krimsky, and Alonzo Plough. "Evaluating Risk Communication: Narrative vs. Technical Presentations of Information about Radon," Risk Analysis, Vol. 12 (no. 1), 1992, p. 34.

[8] Health Canada's Ministerial Message released in November 2012: "Lung Cancer Awareness Month." Available at: http://www.hc-sc.gc.ca/ahc-asc/minist/messages/_2012/2012_11_01-eng.php, accessed June 26, 2013.

makes radon the second cause of lung cancer after smoking.[9] Radon is the largest source of natural radiation exposure,[10] as it represents over 30% of the radiation people are exposed to in a lifetime.[11] 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.[12] Overall, the number of radon-related deaths in Canada from lung cancer is about 25 percent higher than the number of traffic-related deaths, and greatly exceeds the number of deaths due to accidental poisoning and homicides.[13] According to the Canadian Cancer Statistics 2013 report released by the Canadian Cancer Society, the Public Health Agency and Statistics Canada, BC has 139 cancer deaths per 100,000 populations (9,700 deaths in the total population), with the leading cause of cancer death being lung cancer.[14] 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 of indoor radon exposures as natural, therefore, people should have no or little control. This statement is not correct. While sources of radon are ultimately geological, yet natural, high indoor radon exposures may not be. Indoor radon levels can be artificial if they are the consequence of human activities such as building design, construction and usage.[15] In addition, indoor radon concentrations can be easily measured and if found to be high 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 "air-tight." In one example, the owners of a 110 year old house in Peachland of BC (a radon rich area), conducted a six month radon test in various areas of their home .[16] 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

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[9] *Health Canada. "Cross-Canada Survey of Radon Concentrations in Homes - Final Report." Available at: http://www.hc-sc.gc.ca/ewh-semt/radiation/radon/survey-sondage-eng.php, accessed June 26, 2013.*

[10] *Canadian Nuclear Safety Commission, "Natural Background Radiation". Available at: http://www.nuclearsafety.gc.ca/eng/readingroom/factsheets/background-radiation.cfm, accessed June 26, 2013.*

[11] *Canadian Nuclear Safety Commission, "Radon and Health," INFO 0813, ISBN 978-1-100- 17765-6. Available at: http://www.stratecoinc.com/data/pdf/2011/CNSC_RadonandHealth_Feb2011.pdf, accessed June 26, 2013.*

[12] *Health Canada: "Radon Is It In Your Home?" Available at: http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radon_brochure/index-eng.php, accessed June 26, 2013.*

[13] *Statistics Canada, "Mortality, Summary List of Causes – 2009." Available at: http://www.statcan.gc.ca/pub/84f0209x/2009000/t001-eng.pdf, accessed June 26, 2013.*

[14] *Canadian Cancer Society. "Canadian Cancer Statistics publication." Available at http://www.cancer.ca/en/cancer-information/cancer-101/canadian-cancer-statistics-publication/?region=on, accessed June 26, 2013.*

[15] *Radon Prevention and Mediation (RADPAR). "Report: Radon Risk Communications Strategies," RADPAR WP 5 Deliverable D12, September 2011, p. 4.*

[16] *Paterson, Wade. "Peachland couple warns of high radon levels in Okanagan homes," Kelowna Capital News. Available at: http://www.kelownacapnews.com/news/175626021.html, accessed June 26, 2013.*

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 situation at a fish hatchery, in a non-radon rich area in BC. 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 has 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 purpose. According to the "Radon in British Columbia Work Places," a report of Work Safe BC (RS2006-DG09), "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."[17] 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.[18]

Human habits associated with the use of a room can also contribute to elevated levels of indoor radon. For example, in a public building located in a radon-rich area in BC, the offices on the main floor (on slab) were tested for radon. While some offices tested were below the guideline level, three offices tested on the same floor were above the guideline. Thus, the geological location, the structure of the building and the ventilation system could not account for the discrepancies in the results. The only conceivable difference was that the occupants of the three offices had the habit of closing their office doors during and after work, whereas the doors of the offices that tested low were left open all the time. The habit of keeping the office doors closed by the occupants influenced the amount of air flow, thus creating differences in the radon levels tested.

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

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[17] *Ray Copes. "Radon in British Columbia Work Places," RS2006-DG09, Work Safe BC, p. 15.*

[18] *Michael Kitto, Charles Kunz, Craig McNulty, Michael Kuhland and Scott Covert, "Radon Mitigation of Groundwater at a Commercial Fish Hatchery," 1995 International Radon Symposium, V – 1.1.*

of radon may vary widely from house to house, building to building, and may be contingent upon the human "factor." When radon is stated as being naturally occurring, the human component that influences exposure to radon should also be mentioned. More importantly the human component that can prevent the risk from radon exposure should be emphasized; it is easy and inexpensive to test and if levels are high they can be reduced at a reasonable price.

Myth 3: Testing is expensive and the house value will be affected after mitigation. The public has a general perception that radon problems may involve economic 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 remediate any problems that they find.[19] Additionally, concerns over property values may also discourage people from testing, or from sharing or disclosing the results of their tests. Desvousges *et al*. (1989) found that nearly half of homeowners surveyed thought that their home would be worth a lot less even if a radon problem was fixed.[20]

To address concerns surrounding *Myth #3*, risk communication must underscore the fact that testing is not expensive and that radon reduction is reasonably priced, 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.[21] It is important to emphasize that all homes have radon, a person's house is not bad or contaminated if it has radon. Homeowners need to know how much to decide if the level is too high and needs to be fixed.

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.[22] However, they may 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 regulators target their resources.

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[19] *O. Svenson and B. Fischoff. "Levels of Environmental Decisions," Journal of Environmental Psychology, 5 (1985): 55-67. Referenced by Ann Bostrom, Cynthia J. Atman, Baruch Fischoff, and M. Granger Morgan. "Evaluating Risk Communications: Completing and Correcting Mental Models of Hazardous Processes, Part II," Risk Analysis, Vol. 14, No. 5, 1994, p. 796.*

[20] *W. H. Desvousges, V.K. Smith, and H.H. Rink III. "Communicating Radon Risk Effectively: Radon Testing in Maryland," EPA-230-03-89-048, Washington, B.C., U.S. Environmental Protection Agency, 1989, p. 175.*

[21] *Ibid., p. 177.*

[22] *Lipkus et al. "The Visual Communication of Risk," p. 149.*

According to Health Canada's 2009-2011 Cross Canada Radon Survey and Federal Building testing program in BC, homes and buildings with elevated levels of radon were found in thirteen out of sixteen health regions throughout the province.[23] 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 of 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 / have contracted lung cancer from radon and by success stories of bringing radon levels down through mitigation. Thus, effective risk communication needs to involve the use of both qualitative and quantitative information.[24] 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 sub-slab depressurization units.

The characteristics of homeowners also come into play regarding their concerns over health. Older people are less willing to acquire health risk information, whereas people with existing health concerns are more willing to acquire health risk information.[25] Educating young people could be one approach for helping to disseminate health risk information to other age groups.[26] With the support from Health Canada, BC's Interior Health Authority conducted an annual poster contest targeting junior secondary students in radon-rich areas to raise awareness on radon. In addition, through contracting a non-profit 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 BC indicate a diverse ethnic population. Cultural and ethnic

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[23] *Health Canada: "Cross-Canada Survey of Radon Concentrations in Homes - Final Report." Available at: http://www.hc-sc.gc.ca/ewh-semt/radiation/radon/survey-sondage-eng.php,, accessed June 26, 2013.*

[24] *V. Kerry Smith, William H. Desvousges and Ann Fisher. "Communicating Radon Risk Effectively: A Mid-course Evaluation," EPA-230-07-87-029, U.S. Environmental Protection Agency, July 1987, p. 5.*

[25] *F. Reed Johnson and Ann Fisher. "Conventional Wisdom on Risk Communication and Evidence from a Field Experiment," Risk Analysis, Vol. 9, No. 2, 1999, p. 211.*

[26] *RADPAR, p. 30.*

background may affect people's perception 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 socio-cultural environments.[27]

It is well recognized that risk communication may enhance public knowledge and encourage informed consent without resulting in changes in behaviour.[28] Johnson (1988) contends it is a rather naïve assumption that information programs will motivate people voluntarily and rationally to reduce risks.[29] 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. As Doyle *et al*. states, solving the radon problem will require a mix of risk communication, incentives and regulation.[30]

Myth 6: Risk communication is a lone task. Health Canada in BC 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 (E&A) on radon (that is through radon public forums). Given the often apathetic response to the health risk from radon exposure it is very valuable to partner with other relevant stakeholders (other levels of government, health professionals, non-governmental organizations and building and construction industry for example) to strengthen the credibility of the message and increase the reach and impact. 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 BC (the Building and Safety Standards Branch of the Ministry of Energy, Mines and Natural Gas) administers the BC Building Code to prevent radon ingress, and funds Education and Awareness initiatives. Local Health Authorities in radon-rich areas actively promote E&A in their areas, and provide expertise to coordinate testing in public schools and daycare centres.

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[27] *Elaine Vaughan. "The Significance of Socioeconomic and Ethnic Diversity for the Risk Communication Process," Risk Analysis, Vol. 15 No. 2, 1995, pp. 178-179.*

[28] *Dominic Golding, Sheldon Krimsky, and Alonzo Plough. "Evaluating Risk Communication: Narrative vs. Technical Presentations of Information about Radon," Risk Analysis, Vol. 12 (no. 1), 1992, p. 28.*

[29] *F. Reed Johnson, Ann Fisher, V. Kerry Smith and William H. Desvousges. "Informed Choices or Regulated Risk: Lessons from a Study in Radon Risk Communication," May 1988, p. 12.*

[30] *Golding et al. "Evaluating Risk Communication: Narrative vs. Technical Presentations of Information about Radon," p. 34.*

EHP is also a member of the provincial Radon Inter-Government Information and Liaison Group that comprises staff from the BC Centre of Disease Control (BCCDC), BC Ministry of Health, Canadian Mortgage and Housing Corporation (CMHC), BC Lung Association (BCLA), Northern Health Authority (NHA), Interior Health Authority (IHA) and 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 the BC Lung Association; targeting 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, provide information on the National Building Code to prevent radon ingress, and to raise awareness of the Canadian-National Radon Proficiency Program which certifies radon professionals.[31] Thus, with respect to *Myth #6*, Health Canada educates and raises awareness on radon measurement and mitigation by partnering with non-governmental and non-profit organizations.

Conclusion

A good risk communication strategy should create the basis for behavioural change and provide clear actions for people to take.[32] Due to the nature of the radon problem, six key myths have been identified and demystified for effective risk communications:

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 both natural and artificial. Human activities can bring about an increase or decrease of exposure (i.e. through mitigation). The latter message points to the fact that radon risks can be managed.
3. Testing is easy; mitigation is effective and there are ways to address mitigation costs.
4. A radon distribution map is only as good as its intended purpose — for regulators to target their resources. The only way to know if there is a radon problem is to test, as radon concentrations can 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 and qualitative communication approaches.

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[31] *The Canadian National Radon Proficiency Program (C-NRPP). Available at: http://www.nrpp.info/cnrpp.shtml, accessed June 25, 2013.*

[32] *RADPAR, p. 8.*

6. Risk communication is a joint effort at the local and national levels. Federal departments, the province, local health authorities and non-profit organization need to collaborate to share knowledge, expertise, resources and ideas that will encourage testing and mitigation.

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