

## Lung Cancer Risk and Radon in Wisconsin: The Need for Increased Testing and Improved Reporting

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### BACKGROUND

Lung cancer is the leading cause of cancer mortality in Wisconsin and throughout the United States. Each year approximately 2,980 people die from lung cancer in Wisconsin<sup>1</sup> while roughly 158,040 deaths from this disease occur nationally.<sup>2</sup> Tobacco smoke is the primary cause of lung cancer cases,<sup>3</sup> but radon is the second leading cause of the disease contributing to thousands of deaths each year.<sup>4</sup> There is an increased lung cancer risk among smokers exposed to radon. Compared with non-smokers, research shows that smokers' likelihood of developing lung cancer increases exponentially with similar levels of radon exposure.<sup>5</sup>

Radon is a naturally, occurring, odorless radioactive gas that arises from bedrock and soil and is a known human carcinogen.<sup>6</sup> Because it is a gas, radon and its decay products can build up in the air of enclosed areas – particularly spaces that are underground such as basements, caves, and mines. When radon gas is inhaled, radioactive alpha particles are released and invisible solids may become lodged in lung tissue.<sup>7</sup> Exposure to radon can disrupt DNA replication at the cellular level which can lead to cancer.<sup>8</sup> While the specific implications of low-level exposure and exposure among non-smokers are not, as yet, fully understood,<sup>8,9</sup> the United States Environmental Protection Agency (EPA) recommends remediation in homes with radon levels at four picocuries per liter (4pCi/L).<sup>5</sup> However, the bulk of the current evidence suggests there is no lower limit of radon exposure which can be considered unequivocally safe.<sup>6,10</sup>

### RADON IN WISCONSIN

Like much of the northern United States, the majority of Wisconsin counties have moderate to high potential for indoor radon.<sup>11</sup> Wisconsin has geological features associated with creating relatively high levels of radon, particularly in specific regions. **Figure 1** maps the percentage of tested homes in each Wisconsin zip code that have elevated levels of radon (i.e., levels higher than the EPA's action level of 4pCi/L). The data in the map represent the aggregated results from 131,877 radon tests reported to the Wisconsin Department of Health Services from 1991-2012. The darkest two shades indicate areas of the state where more than half of tested homes have elevated levels of radon. In areas where a higher percentage of homes have elevated radon levels, it is certainly essential that all untested homes be tested. However, it is important to note that radon levels may be high in individual homes in zip codes where the majority of tested homes are below the EPA threshold. Factors such as the age of a home and the result of a neighbor's radon test do not adequately predict the risk of elevated radon. Testing a home is the only way to be certain of the radon level in that particular home. The EPA recommends that all homes be tested for radon every two years.<sup>12</sup>

Caution is warranted in interpreting the data shown in **Figure 1**. The map reflects the results of radon tests that have been conducted using kits provided by the Wisconsin Department of Health Services

### Summary

**Background** – Lung cancer is the leading cause of cancer mortality in Wisconsin and in the U.S. While the majority of lung cancers are caused by tobacco smoke, radon exposure is the second leading cause of the disease.

**Radon Testing and Mitigation in Wisconsin** – Local health departments throughout Wisconsin currently provide radon testing kits at low cost to residents. Evidence suggests, however, that testing and mitigation remain low. Moreover, current data reporting systems are inadequate leaving stakeholders with an incomplete picture of Wisconsin's risk.

**Policy Implications** – Increased testing and reporting would reduce statewide cancer risk and strongly enhance Wisconsin's ability to protect the health of its residents. Some states have found success with legislation that aims to increase testing and awareness of the risks of radon. Even without legislative action, however, informal policies and collaborative efforts between stakeholders could increase testing, improve data collection, and increase appropriate mitigation.

and local health departments throughout the state (see the following section for further details). As such, some zip codes include many test results while others include very few. Approximately 3% of zip codes had fewer than five tests over the time period. Thus, these numbers cannot be said to represent all, or even most, of the homes in Wisconsin. Some homes may never have been tested while others may have been tested without the results being reported. Improvements in the collection and reporting of these data are critical steps to expand tracking of radon data in Wisconsin and improve estimates of the risk profiles throughout the state.

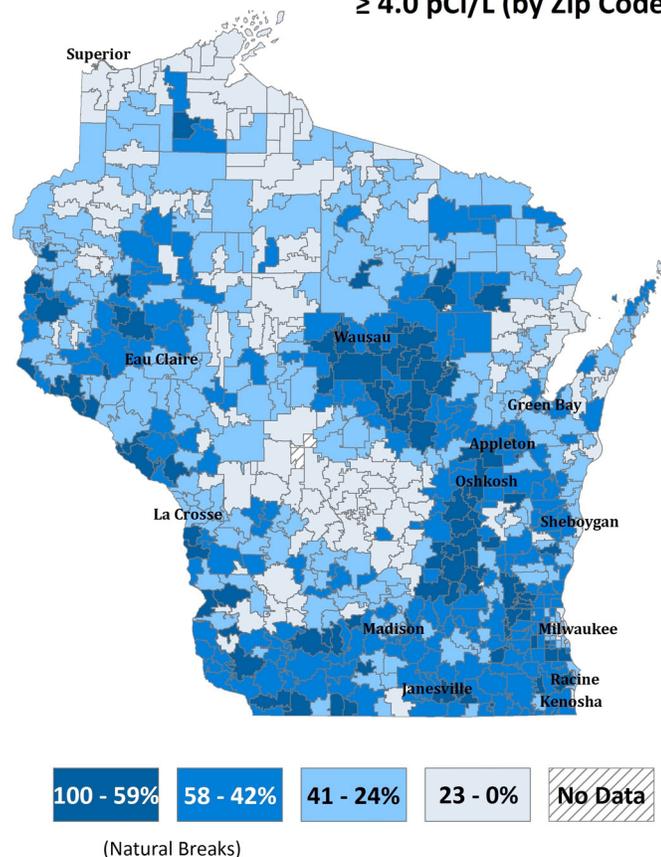
## TRACKING TESTS AND MITIGATION IN WISCONSIN

The Wisconsin Department of Health Services contracts with local public health agencies to maintain Radon Information Centers (RICs) throughout the state to increase radon testing and provide information and assistance. The RICs educate homeowners about the importance of radon testing, conduct outreach around radon mitigation (i.e., the processes by which concentrations of radon in homes or other structures is reduced),<sup>13</sup> and provide radon test kits. Radon test kits can be purchased from RICs for approximately \$20. In 2013, the sixteen RICs collected results from 5,475 radon test kits. These results represent slightly more than half of the approximately 10,000 kits that are distributed by RICs each year.

**Figure 2** provides an overview of radon testing in Wisconsin based on the data collected from the RICs. In spite of the large number of kits distributed by the RICs, less than 1% of all Wisconsin

**Figure 1.**

**Percent of Indoor Radon Household Test Results  $\geq 4.0$  pCi/L (by Zip Code)**



households were estimated to have been tested for radon in 2013. As noted previously, however, these data are incomplete. Wisconsin has no statutory or administrative-rule authority to require radon testing or reporting on testing or mitigation. While the RICs provide many home testing kits, these kits are also sold at hardware stores throughout the state. Data on how many kits are sold at hardware stores are not collected and the test results from those kits are rarely reported to the Wisconsin Department of Health Services. As a result, the true percentage of homes tested annually is currently unknown.

Data on the number of homes that undergo mitigation for radon are similarly lacking. While the Wisconsin Department of Health Services maintains a list of contractors in the state who have

national certification for radon mitigation, the state itself does not certify these contractors. Currently radon testing and mitigation can be conducted in Wisconsin without certification, and no one, certified or not, is required to report data to the state health department. While health officials gather some information through informal communications with certified mitigators, this method is insufficient to capture the true picture of what is happening statewide. For example, based on some data collected from certified contractors within the state, it appears that as many as 6,000 homes may have had radon mitigation services in 2013 and that mitigations may be on the rise overall. However, this estimate is likely inaccurate as it is based on the reports of only half of the certified contractors in the

**FIGURE 2.  
RADON TESTING BY THE NUMBERS**

**2,633,330**

ESTIMATED NUMBER OF HOUSEHOLDS IN WISCONSIN<sup>1</sup>

**5-10%**

ESTIMATED PERCENTAGE OF WISCONSIN HOUSEHOLDS THAT HAVE RADON LEVELS ABOVE EPA GUIDELINES<sup>2</sup>

**10,000**

ESTIMATED NUMBER OF RADON TEST KITS DISTRIBUTED BY RADON INFORMATION CENTERS (RICs) IN 2013

**55%**

ESTIMATED PERCENTAGE OF RADON KITS USED AMONG THOSE DISTRIBUTED BY RICs IN 2013

**LESS THAN 1%**

ESTIMATED PERCENTAGE OF WISCONSIN HOUSEHOLDS THAT TESTED FOR RADON IN 2013<sup>3</sup>

1. US Census, 2013.

2. <https://www.dhs.wisconsin.gov/radon/radon-measurements.htm>.

3. Calculation based on and estimate of 2,633,330 households in Wisconsin taken from the 2013 US Census. Calculations only include tests distributed and reported to Wisconsin Radon Information Centers.

state and excludes all uncertified contractors. Informal information also suggests that builders are increasingly seeking to construct radon resistant homes. Still, no data are available on the number of homes being built to be radon resistant. This paucity of adequate data is an important deficiency for the state when considering how to assess the risk of lung cancer due to radon exposure among Wisconsin residents. Better data could help to reduce cancer risk in Wisconsin by helping stakeholders to target areas in need of increased radon testing and mitigation.

## **MINNESOTA AND ILLINOIS: CURRENT APPROACHES TO RADON**

Neighboring states have worked to increase radon testing through a variety of strategies. Most recently, Minnesota passed a Radon Awareness Act which went into effect in January of 2014.<sup>14,15</sup> The goal of this legislation is to increase the amount of information about radon given to property buyers in real estate transactions. Previously it was only necessary for sellers to check a single box stating whether or not radon

was a known environmental concern for the property. Under the new act, sellers are required to inform buyers about any past radon testing, any implemented radon reduction efforts, and the result of the most recent test.” Sellers are also required to provide information from the Minnesota Department of Health about radon and real estate transactions.<sup>16</sup>

The anticipated result of Minnesota’s new act is an increase in radon testing during real estate transactions and an increased awareness of radon as an important risk factor for cancer.<sup>15</sup> Preliminary evidence already shows a two-fold increase in mitigation in Minnesota for 2014 compared to 2013 – a larger increase than has been seen in prior years.<sup>17</sup>

Illinois has had a Radon Awareness Act in place since the beginning of 2008.<sup>18</sup> As a result of that legislation, Illinois has seen a four-fold increase in the number of radon tests conducted during real estate transactions. At present nearly one-third of all real-estate transactions in Illinois include a radon test.<sup>15,17</sup> These findings in Minnesota and Illinois suggest that legislation can become a catalyst for improvement in testing, mitigating, and improving cognizance of the risks of radon – all of which can have the long-term effect of reducing lung cancer risks for the general population.

While legislation may serve as one important route to increased testing and mitigation, other systems or policies may be nearly as important for improving data collection and reporting. In Minnesota, professional providers of radon services (i.e., testing and mitigation) are asked quarterly to report the number of tests conducted, the levels of radon found, and an indication of any mitigation performed.” While Minnesota radon professionals

are not certified by the state, they obtain training and certification through recognized programs like the National Radon Proficiency Program (NRPP) or the National Radon Safety Board (NRSB) – similar to Wisconsin. However, those contractors that wish to remain on Minnesota’s list of certified radon professionals must submit mitigation numbers to the state. The quarterly reporting is reinforced through the quarterly continuing education courses offered to professionals, facilitating a high response rate. While this system of reporting is not codified in legislation, it adequately serves to sustain reporting and data collection across the board and provides Minnesota with better estimates of the true radon risk profile in the state. In contrast, in Wisconsin there is no mechanism in place to systematically receive reports from professional radon service providers. While these providers are often happy to report the data, the lack of an organized structure makes it difficult for all parties to keep track of reporting or missing follow-up reports.

## **POLICY IMPLICATIONS**

The most pressing radon-related needs in Wisconsin are for: 1) increased testing and mitigation 2) improved collection and systematic reporting of testing and mitigation data. Better collection and reporting will lead to more complete and accurate data, which will improve the understanding of Wisconsin’s radon exposure risk profile. The Awareness Acts implemented by Illinois and Minnesota provide one mechanism for increasing the number of properties getting tested, but other systematic efforts could serve a similar purpose. Informal policies, such as those used by Minnesota in collecting data from professional radon service providers, could improve

the current state of data and knowledge of radon exposure risk. As such, while policy makers may wish to consider legislative options, other opportunities to systematically improve testing and reporting could be pursued by other relevant stakeholders.

The soon-to-be-released Wisconsin Comprehensive Cancer and Control Plan 2015-2020 makes “decreasing exposure to radon” a priority and, in this way, is comparable to other Comprehensive Cancer Control Plans in the upper Midwest (i.e., Minnesota, Iowa, Illinois, and North Dakota). Its inclusion, in part, is meant to raise awareness of this preventable risk factor for lung cancer. It is important for individuals and families to consider testing their homes for radon. People are also encouraged to strongly consider a radon test when buying or selling a home. While some areas of the state have a higher percentage of homes with actionable radon levels (see **Figure 1**), there is no way to know for certain the level of radon in a home unless a test is performed. RICs throughout the state provide inexpensive testing kits to consumers and mitigation services are typically about the price of an average home repair. More information on testing, mitigation, or radon generally is available at [www.lowradon.org](http://www.lowradon.org).

## CONCLUSIONS

Exposure to radon is the second leading cause of lung cancer, and smokers with radon exposure

have a particularly high risk of cancer.<sup>5,6</sup> Testing for radon and subsequently mitigating homes with radon levels above the EPA threshold can protect Wisconsin residents from future lung cancers. At present, Wisconsin lacks necessary data on numbers of homes tested, levels of radon in homes tested, and numbers of homes mitigated that would inform the level of exposure and reduce exposure risk. Increased testing and reporting would strongly enhance Wisconsin’s knowledge and ability to protect its residents from this cancer risk.

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## REFERENCES

1. American Cancer Society, Midwest Division. *Wisconsin Cancer Facts & Figure 2013-2014*. Madison, WI. 2014 Retrieved December 17, 2014 from [http://www.wicancer.org/documents/wifactsfigures2013\\_final\\_000.pdf](http://www.wicancer.org/documents/wifactsfigures2013_final_000.pdf).
2. Jemal A, Bray F, Center MM, Ferlay J, Ward E, Forman D. Global cancer statistics. *CA Cancer J Clin*. 2011; 62(2):69-90.
3. United States Department of Health and Human Services. *The Health Consequences of Smoking: 50 Years of Progress. A Report of the Surgeon General*. Atlanta, GA: Centers for Disease Control; 2014.
4. National Research Council (United States). *Committee on the Health Risks of Exposure to Radon (BIER VI): Health Effects of Exposure to Radon*. Washington, DC: National Academy Press; 1999.
5. United States Environmental Protection Agency. *A Citizen’s Guide to Radon: The Guide to Protecting Yourself and Your Family From Radon*. Washington, DC. 2012. Retrieved December 17, 2014 from <http://www.epa.gov/radon/pubs/citguide.html>.
6. World Health Organization. *Handbook on indoor radon. A public health perspective*. 2009. Retrieved December 2, 2014 from [http://www.who.int/ionizing\\_radiation/env/radon/en/index1.html](http://www.who.int/ionizing_radiation/env/radon/en/index1.html).
7. Keith S, Doyle JR, Harper C, Mumtaz M, Tarrago O, Wohlers DW, Diamond GL, Citra M, Barber LE. Toxicological Profile for Radon. Atlanta, GA. 2012. Retrieved December 22, 2014 from <http://www.ncbi.nlm.nih.gov/books/NBK158784>.
8. Miller RC, Randers-Pehrson G, Geard CR, Hall EJ, Brenner DJ. The oncogenic transforming potential of the passage of single alpha particles through mammalian cell nuclei. *Proc Natl Acad Sci USA*. 1999; 96(1):19-22.
9. Torres-Durán M, Barros-Dios JM, Villar AF, Ruano-Ravina A. Residential radon and lung cancer in never smokers. A systematic review. *Cancer Lett*. 2014; 345:21-26.
10. Field RW, Smith BJ, Steck DJ, Lynch CF. Residential radon exposure and lung cancer: variation in risk estimates using alternative exposure scenarios. *J Expo Anal Environ Epidemiol*. 2002;12:197-203.
11. United States Environmental Protection Agency. *EPA Map of Radon Zones*. 2014. Retrieved December 17, 2014 from <http://www.epa.gov/radon/zonemap.html>.
12. United States Environmental Protection Agency. *Consumer’s Guide to Radon Reduction*. Washington, DC. 2013. Retrieved December 12, 2014 from <http://www.epa.gov/radon/pubs/consgrid.html>.
13. Minnesota Department of Health. Radon Mitigation Systems. 2014. Retrieved December 22, 2014 from <http://www.health.state.mn.us/divs/ch/indoorair/radon/mitigationsystem.html>.
14. Minnesota Radon Awareness Act. Minnesota Statute 144.496. 2014. Retrieved December 2, 2014 from <https://www.revisor.mn.gov/statutes/?id=144.496>.
15. Minnesota Department of Health. New law requiring greater radon disclosure during home sales begins in January. 2014. Retrieved December 2, 2014 from <http://www.health.state.mn.us/news/pressrel/2013/radon122713.html>.
16. Staltzman R. Minnesota Radon Awareness Act. *StarTribune*. January 30, 2014. Retrieved December 10, 2014 from <http://www.startribune.com/local/yourvoices/242727581.html>.
17. Tranter D. Personal communication regarding Minnesota and Illinois radon data. With: Creswell PD. December 2, 2014.
18. Illinois Radon Awareness Act. Illinois Statute 420 ICLS 46. 2008. Retrieved December 2, 2014 from <http://www.ilga.gov/legislation/ilcs/ilcs3.asp?ActID=2913&ChapterID=37>.



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