

Protecting Ireland's Homes from Radiation

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ACADEMIC



HEALTH



POLITICAL



SCIENTIFIC



ENVIRONMENTAL

SUMMARY

Radon is a naturally occurring radioactive gas. People exposed to it can't smell or see it, so they are unaware of the danger they are facing and they do not take action to avoid it. Radon is a class A carcinogen, or cancer-causing agent, and in Ireland 250 deaths per year can be attributed to Radon exposure. More people die from Radon poisoning in Ireland than are killed by road traffic accidents. Our research at UCD has improved how Radon is measured. We have calculated the risk from Radon, we have influenced government policy and we have ultimately saved lives.

We developed a new procedure that allowed the EPA to accurately measure annual Radon levels using three-month measurements so exposure levels could be detected faster.

RESEARCH DESCRIPTION

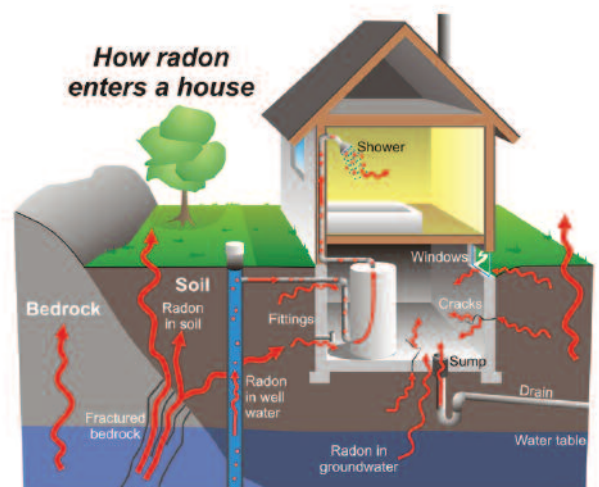
High levels of Radon in homes result in dangerous levels of radiation and lead to five deaths per week in Ireland. If homes with Radon problems can be identified, then they can be remediated or fixed easily. The problem in Ireland is finding out which homes are most at risk. In 2004, we began collaborating with the Environmental Protection Agency (EPA), to answer this question. We have conducted several major research projects that have developed new approaches for measuring the Radon risk in Ireland.

We developed a new procedure that allowed the EPA to accurately measure annual Radon levels using three-month measurements so exposure levels could be detected faster.

We designed two new national Radon surveys that allowed both the National Average Radon Level and the Population Risk to be measured using smaller samples and therefore more frequently.

As an example of what we uncovered, in 2003 a house in Castleisland was found to have exceptionally high Radon levels. In a single day, the residents received a radiation dose equivalent to what a worker in a nuclear power plant would get in a year. Our work on the Castleisland Radon Survey led to two academic papers that for the first time properly quantified the risk to people in Castleisland. Our research increased the level of remediation in this area, consequently saving lives. It also attracted considerable media and political attention.

Our research has also improved our understanding of how building characteristics are related to indoor Radon levels.



RESEARCH IMPACT

The scientific impact of our work can be seen from its key role in the National Radon Control Strategy, which aims to reduce the national risk from Radon. In order to reduce risk from Radon, we need the ability to measure risk accurately and to monitor the change in risk over time.

Before our research, the only national measure of the risk available was from the 2002 National Radon Survey which measured indoor Radon levels in more than 11,000 homes in Ireland. These measurements needed radiation detectors to be placed in houses for 12 months and the survey took several years to complete. This meant that the EPA had been unable to update the 2002 National Radon Survey and so they had no way of establishing what the current Radon situation was.

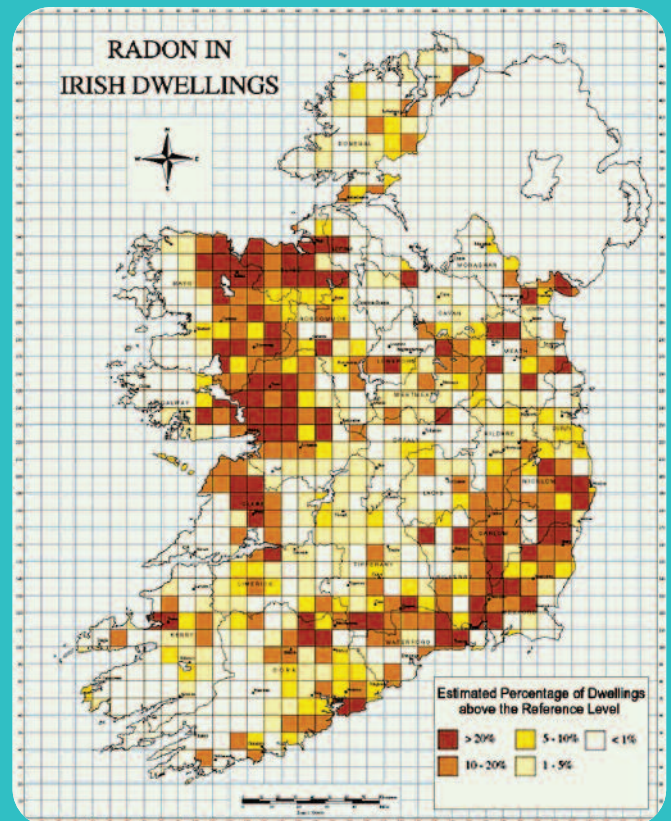
Our work has greatly simplified the process of measuring the National Radon Average and Population Risk. We developed a method to accurately work out annual Radon levels in a home based on measurements taken in just three months. We have also designed two sampling schemes that mean we can work out both the National Average Radon Level and the Population Radon Risk from only 600 homes, rather than the 11,000 needed before. This reduces the cost and time involved in conducting a National Radon Survey. In January 2017, we published a paper jointly with the EPA which for the first time in 15 years quantified the National Average Radon level and found that it is 13% lower than in 2002. This new simplified approach has attracted a lot of interest internationally.

One example of the policy impact is a project where we demonstrated that one-month Radon measurements could be used to establish with a degree of confidence whether homes exceeded the National Radon Reference Level. This very important result allowed the EPA to lobby for the introduction of Radon measurements into the conveyancing process for house sales. The means all house buyers will be provided with Radon measurements for their houses, showing immediately whether they need to remediate their houses to reduce the danger from Radon. This stands to save many lives. We have also advised Government agencies such as the Health Service Executive, the Geological Survey of Ireland and the Department of Housing Planning and Local Government on radon measurement issues.

Our work has had an academic impact in several ways. We have published 15 academic papers, which have been downloaded tens of thousands of times. Our 2008 paper was chosen by the Institute of Physics as a highlight of 2008 for the Journal of Radiological Protection. We have received funding for two PhDs from the Irish Research Council. One of our PhD graduates went on to a permanent lecturing post at the University of Oxford.

The International Atomic Energy Agency recognised our expertise by appointing us to lead its Expert Mission to Montenegro in 2015 to advise on Radon Measurement.

In summary, our work underpins the EPA's efforts to reduce Radon levels and save lives.



"I know what excellent advice you offered in Ireland and I am sure that Montenegro would benefit greatly from your involvement in this project."

Tony Colgan, Head of the Radiation Protection Unit, IAEA, Vienna.

"We have worked with Patrick on radon in Ireland for over 10 years so Patrick has much experience of radon. We have jointly published peer-reviewed papers on various aspects of the radon problem in Ireland. More recently Patrick has helped us with our National Radon Survey which is an update to the National Survey we published in 2002."

David Fenton, Manager Radon and Radiation Measurement Services, Environmental Protection Agency Office of Radiological Protection.

REFERENCES

Funding

Recently I received funding for a new PhD student to work on this research under 2017 Irish Research Council Government of Ireland Postgraduate Scholarship Scheme.

I have received several distinct funding awards from the EPA Office of Radiological Protection and its predecessor the Radiological Protection Institute of Ireland.

In December 2015 I led a mission on behalf of the International Atomic Energy Agency to Montenegrin Academy of Sciences and Arts to advise them on developing radon measurement protocols in Montenegro. I also received funding from the International Atomic Energy Agency (IAEA) for this work.

Impact in Government

In addition to its impact on policy in both local and central Government and agencies like the HSE, the results of the Castleisland Radon Survey were debated in the Dáil (Irish parliament).

<http://oireachtasdebates.oireachtas.ie/debates%20authoring/debateswebpack.nsf/takes/dail2005022300027?opendocument>

Peer Reviewing:

I am a reviewer for papers on statistical issues in radiological protection including the two most prestigious journals: the Journal of Environmental Radioactivity and the Journal of Radiological Protection.

Journal Publications:

- A. Dowdall, P. Murphy, D. Pollard, D. Fenton (2017) 'Update of Ireland's national average indoor radon concentration - Application of a new survey protocol'. Journal of Environmental Radioactivity, <https://doi.org/10.1016/j.jenvrad.2016.11.034>
- B. Burke, O. Murphy, P.; (2011) 'The use of volunteer radon measurements for radon mapping purposes: an examination of sampling bias issues'. Journal of Radiological Protection, 31 :319-328. <https://doi.org/10.1088/0952-4746/31/3/001>
- C. Burke, O. Murphy, P (2011) 'Regional variation of seasonal correction factors for indoor radon levels'. Radiation Measurements, 46 :1168-1172. <https://doi.org/10.1016/j.radmeas.2011.06.075>
- D. Murphy, P. et al.; (2010) 'Estimation of seasonal correction factors through Fourier Decomposition Analysis - a new model for indoor radon levels in Irish homes'. Journal of Radiological Protection, 30 (13):433-443. <https://doi.org/10.1088/0952-4746/30/3/002>
- E. Murphy, P., Organo, C; (2008) 'A comparative study of lognormal, gamma and beta modelling in radon mapping with recommendations regarding bias, sample sizes and the treatment of outliers'. Journal of Radiological Protection, 28 :293-302. <https://doi.org/10.1088/0952-4746/28/3/001>
- F. Organo, C., Murphy, P; (2007) 'The Castleisland Radon Survey - follow-up to the discovery of a house with extremely high radon concentrations in County Kerry (SW Ireland)'. Journal of Radiological Protection, 27 :275-285. <https://doi.org/10.1088/0952-4746/27/3/002>

Conference Publications:

- A. Alison Dowdall, Patrick Murphy, David Fenton, David Pollard (2016) Development and application of a survey protocol to update Ireland's national average indoor radon 8th International Conference on Protection Against Radon at Home and at Work, Prague 2016
- B. Patrick Murphy (2015) Updating the national average indoor radon concentration for Ireland: methodology and preliminary results. 12th Irish National Radon Forum
- C. Heather Rochford, David Fenton, Patrick Murphy and Laura Regan; (2010) A Comparison of One and Three Month Radon Measurements in Ireland Proceedings of the Third European IRPA Congress, Helsinki
- D. Burke, Orlaith, Long, Stephanie, Murphy, Patrick, Organo, Catherine, Fenton, David and Colgan, Peter Anthony ; (2010) New seasonal correction factors for Radon levels in Irish homes Proceedings of the Third European IRPA Congress, Helsinki
- E. Orlaith Burke, Patrick Murphy, Stephanie Long, David Fenton and Catherine Organo; (2009) Modelling Seasonal Effects in Radon Emissions Data 2009. Joint Statistical Meetings, Washington, DC.
- F. Murphy, P and Organo, C; (2008) Beta versus Log-Normal Modelling: Improving Radon Mapping Techniques, International Biometric Conference
- G. Burke, O., Murphy, P., Fenton, D. and Organo, C. ; (2008) Modelling Seasonal Effects in Irish Indoor Radon Levels, International Biometric Conference
- H. Murphy, P. and Organo, C; (2008) Developing New Methodologies To Estimate the Proportion of Homes in a Region with Indoor Radon Levels Exceeding a Reference Threshold. Joint Statistical Meetings, Denver, Colorado
- I. Patrick Murphy; (2007) Statistical Issues in Radon Mapping, Conference of Applied Statistics in Ireland