

World Health Organization's International Radon Project 2005-2008

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Abstract. Recent epidemiological studies of people exposed to indoor radon have confirmed that radon in homes is a serious health hazard that can be easily mitigated. To address the issue at an international level, the World Health Organization (WHO) established the International Radon Project (IRP). The project was launched in January 2005 with its first meeting attended by 36 experts representing 17 countries. The project's scope and the key objectives were outlined at this meeting and later refined:

- To identify effective strategies for reducing the health impact of radon;
- To promote sound policy options, prevention and mitigation programs (including monitoring and evaluation of programs);
- To raise public, political and economical awareness about the consequences of exposure to radon (including financial institutions as target group);
- To estimate the global health impact of exposure to residential radon using available data on radon worldwide.

WHO and its member states strive through the WHO-IRP to succeed in putting indoor radon on the environmental health agenda in countries with lower awareness of radon as a health problem and in strengthening local and national radon-related activities in countries with ongoing radon programs.

Two subsequent working meetings were held: in March, 2006 in Geneva with 63 participants from 25 countries, along with representatives of the International Atomic Energy Agency (IAEA), the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the International Commission on Radiological Protection (ICRP), and European Commission (EC); and in March 2007 in Munich with 61 participants from 27 countries. Both meetings reviewed the IRP progress and focused on the two main outputs: "The WHO Report on the Global Burden of Disease (GBD) due to Radon" and "The WHO Radon Handbook". The former applies the WHO methodology for GBD assessment and considers ways to graphically map residential radon concentrations worldwide, and has also produced the interactive web based map of national levels of residential radon around the world. The WHO Radon handbook includes chapters on exposure guidelines, measurement, mitigation, cost-effectiveness and radon risk communication, as well as a background chapter and recommendations for policies leading to radon risk reduction. Both WHO-IRP outputs provides sound, evidence-based guidance and tools for radon control measures including the cost-effectiveness analysis of available approaches.

KEYWORDS: *radon, residential, risk, lung cancer, mitigation, policy*

1. Introduction

Reducing the disease burden associated with environmental causes is a core objective of the World Health Organization (WHO). The Radiation and Environmental Health Team within the Department of Public Health and Environment specifically deals with all aspects of radiation and health, including the assessment of radiation risks, the provision of sound policy advice to WHO Member States and of medical support in radiation accidents.

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Indoor radon is the ionizing radiation source most relevant for exposure of the public in many countries [1]. In 2005 results of pooled epidemiological case-control studies on the risk of lung cancer from indoor radon exposure have become available. Risk estimates from the European [2, 3] and North American [4] pooling studies are quite similar and indicate a linear increase of lung cancer risk with increasing residential radon exposure. There is also good consistency with results of large studies among miners exposed to radon at much higher levels. Globally an estimated 6-15% of lung cancers are thought to be due to radon, underlining the importance of radon as one of the most important environmental carcinogens [5]. However, WHO Member States have noted that both policy makers and the public at large are not acting sufficiently on this problem, even though prevention and mitigation of residential radon exposures is relatively easily achievable, mainly through specific installations and modifications in building and construction. WHO therefore launched the International Radon Project (IRP) in 2005 [6, 7], making use of its ability to bring together international stakeholders and develop global approaches to important health problems.

2. Scope and objectives of the WHO-IRP

The WHO-IRP has been conceived as a global project with key international partners, bringing together countries and experts with longstanding radon expertise with countries just considering or starting radon-related activities. The overall aim of the project is to reduce the population disease burden due to radon in homes, with an initial time frame from 2005-2007. The first meeting in 2005 was attended by experts from 17 countries and proposed a preliminary set of project objectives that were discussed and refined subsequently. Thus, the agreed objectives of the WHO-IRP are:

- To identify effective strategies for reducing the health impact of radon
- To promote sound policy options, prevention and mitigation programs (including monitoring & evaluation of programs)
- To raise public, political and economical awareness about the consequences of exposure to radon (including financial institutions as target group)
- To estimate the global health impact of exposure to residential radon using available data on radon worldwide

Participants from more than 30 countries have become involved in the project, with particularly strong presence from the European Region and the Americas, but also including several Asian countries. Representatives from the European Commission Joint Research Centre (JRC), the International Atomic Energy Agency (IAEA), the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), and the International Commission on Radiological Protection (ICRP) have been participating in the project.

3. WHO IRP mode of action

The International Radon Project is partially funded by extra-budgetary contributions from WHO member states, and has its secretariat in Geneva. The working groups are the backbone of the project, while WHO organizes the regular flow of information and exchange of ideas mainly through regular electronic communications, newsletters and the WHO radon webpage¹, and through an annual project meeting. Three international meetings have taken place, two in Geneva in January 2005, and in March 2006, and one in March 2007 in Munich. An additional meeting of the editorial board for the main project products has been organized in December 2007 in Bonn.

4. IRP Topical Working Groups

The WHO IRP consists of six working groups that focus on issues ranging from health risk assessment to radon measurement, radon prevention and mitigation, economic considerations of radon control, radon risk communication and guidance for National Radon Programs. In this context the setting of radon Reference Levels were intensively discussed in most of the working groups.

¹ http://www.who.int/ionizing_radiation/env/radon

4.1. Risk assessment

Through the recently published pooled studies of indoor radon and lung cancer risk, the project benefits from an excellent epidemiological basis. The WHO-IRP has been fortunate to include a large number of co-authors of the new studies among its participants. The risk assessment group has reviewed and refined the existing epidemiological data for the WHO-IRP. Since absolute risks may be more useful for risk communication than relative measures, the group has worked on the quantification of the number of deaths attributable to radon alone and to radon and smoking combined. Also the group, jointly with UNSCEAR, has collected a large database of worldwide radon indoor data [8]. One of the core results of the group is their call to not only set attention on houses with high levels of radon where the individual risk of dwellers may be comparatively high, but also to point on the need to lower overall radon levels since exposures in the mid-range distribution contribute most to the total population exposure. The epidemiological results clearly show that the reduction of radon levels across the housing stock of a country carries the larger potential benefit in terms of reducing the overall number of lung cancers in the population.

For the ongoing global radon burden of disease assessment the methodological experience gained in the pooling projects and related studies will be combined with available data on radon levels and lung cancer worldwide. In addition to the WHO radon handbook, the radon burden of disease study is expected to be one of the main outputs of the WHO-IRP.

4.2. Measurement

Worldwide there is extensive expertise in radon measurement in many different settings and conditions. The WHO working group developed an overview of current measurement practices and provided a large number of important recommendations on actual measurement issues. Radon gas concentration is generally considered a good, simple and cost-effective surrogate for the estimation of radon decay product concentration. The group confirmed that in order to assess the annual average radon concentration within a home, devices that provide a long-term integrated radon measurement are preferred to short term tests.

The working group used a WHO survey on radon to collect information on commonly used measuring devices. The most frequent radon measuring devices used by member countries were alpha-track detectors (ATDs), electret ion chambers (EICs), and activated charcoal detectors (ACDs). The different devices were then reviewed in detail in the WHO radon handbook. A major issue in radon measurement is quality assurance. The working group provides detailed guidance on quality assurance protocols and on the different components of a high quality radon measurement program. The international adoption of standardized measurement protocols would be an important step towards improved comparability of radon data.

4.3 Prevention and Mitigation

Prevention and mitigation are core activities for the practical work to reduce indoor radon. Prevention focuses on newly built houses whereas mitigation refers to existing homes with increased radon levels. For both prevention and mitigation a range of technical information exists which were reviewed by the working group. Mitigation approaches range from barriers and simple ventilation approaches to technically more demanding ventilation and depressurization strategies. Radon measurements are needed prior to and after installation of radon control systems in order to assess their efficacy in a given environment. The role of building research and of training for personnel as well as an overview and recommendations on the different prevention and mitigation techniques are highlighted in the WHO radon handbook..

4.4 Cost – effectiveness in radon control

An additional working group of the WHO-IRP discussed the current knowledge and recommendations on economic evaluation of radon prevention and mitigation. For an economic evaluation of alternative

radon actions, cost-effectiveness analysis can be used. In this approach the ratio of net health-care costs to net health benefits (that is, beneficial effects minus any adverse consequences such as side effects) is calculated for each of a variety of different actions or policies, providing an index with which these actions can be rank-ordered and prioritized. Previous analyses indicate that preventive measures in all new buildings are cost-effective in areas where more than 5% of the present housing stock has radon concentrations above 200 Bq/m³. In some low risk areas the measurement costs are sometimes higher than the mitigation costs for existing dwellings due to the high number of homes that will have to be tested compared to the proportion of homes mitigated.

A cost-effectiveness analysis involves several key elements, such as a clear definition of the program to be evaluated, the comparison of actions, and an explicit study perspective. Furthermore, the time horizon and discounting needs to be considered, as well as a comprehensive discussion of uncertainties. Usually, a series of assumptions are required, which need to be clearly described. Decisions about the acceptability of calculated cost-effectiveness ratios depend on the country context and policy, but the approach provides a pragmatic basis for the economic quantification of radon actions.

4.5 Risk communication

The communication of radon-related health risk and activities to raise awareness were topics of another WHO-IRP working group. With few exceptions, radon risk communication has not been highly successful in the past, even though a wide spectrum of activities had been utilized to strengthen awareness in the different target groups. The WHO-IRP has reviewed these activities and provides practical advice on how to frame and sustain radon risk communication. According to the results of this working group, it is helpful to work with a small number of clear core messages that highlight both radon risks and opportunities to reduce this risk for one's family and oneself.

A specific challenge for risk communication is the radon-smoking relationship. In absolute terms, most radon related lung cancers occur among smokers. On the other hand, the relative increase risk per 100 Bq/m³ is similar among smokers and non-smokers [1]. This relationship calls for an integrated risk communication approach, highlighting the joint risk of smoking and radon.

5. National radon programs

This working group discussed the objectives, tasks and components of a National Radon Program. Representative surveys are a core tool to assess the need for further action on indoor radon levels in a country. Once a need to act has been established, the WHO-IRP recommends to develop and implement a well structured and multi-layered radon program at national or regional level. Besides surveys of radon concentrations, the radon program should provide a joint framework for risk assessment, radon measurement, radon prevention and mitigation approaches and risk communication strategies in the respective country.

Reference Levels for indoor radon exposures are intended to indicate a level of exposure beyond which remediation action should be taken. However, given the epidemiological associations presented earlier, these levels cannot be interpreted as rigid boundaries between harm and non-harm. Therefore, protective activities may well be justified below reference levels, in line with the ALARA principle and especially with a view to reducing the overall radon concentrations in the housing stock.

Radon Reference Levels (at times also called Action levels) are implemented by national authorities. The WHO-IRP has reviewed the existing recommendations for reference values in the light of most recent evidence and is proposing a reference level of <400 Bq/m³ for residential dwellings. This recommendation notes the actual values chosen by most countries surveyed by WHO [9] and is also consistent with ICRP dose value for residential radon reference level (<10mSv/year) [10], when the UNSCEAR conversion factor is applied (40Bq/m³ = 1 mSv) [5]. However, it should be noted that reference levels need to be seen as part of an overall strategy to reduce the health burden from radon, including other approaches, e.g. national anti-tobacco programs. This view takes into account the fact

that most radon – associated lung cancers actually occur among persons exposed to radon concentrations below reference levels.

6. Conclusion

The longstanding experience of several countries aiming to reduce radon levels in homes suggests that sustained action on radon is a challenging goal, in particular as the benefit in terms of reducing lung cancer risk can only be demonstrated after a longer time period. In addition the effect of smoking, the main lung cancer risk factor, needs to be considered in risk assessments and in risk communication aimed to inform the public about ways to reduce lung cancer risk.

Many challenges remain with respect to radon data comparability, approaches to measurements, voluntary or compulsory mitigation and other issues. The WHO-IRP may not be able to solve all these problems but should be seen as an important resource for Member States in their efforts to effectively reduce lung cancer risk due to radon. WHO hopes to support these efforts by publishing and widely disseminating the WHO Radon Handbook and a “Global Burden of Disease from Radon” report. Strong international cooperation can be one of the core steps to lower the radon-associated health burden worldwide.

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