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Risk Communication as a Strategic Tool to Raise Awareness of Radon Health Effects and to Reduce Exposures of the Public.

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Excluding accidental radiation exposures and those received in radiation therapy the largest and most variable component of dose to the public is due to exposure to the naturally occurring radioactive gas radon and its progeny in their homes. On a global basis the annual dose to the general population from radon has been estimated to be 1.2 mSv per year. In many countries however, doses of some tens of mSv/year occur in high radon areas. The principal epidemiologically established risk from radon exposure is lung cancer. Due to synergistic effects in combination with smoking it can greatly amplifies the already high lung cancer risk due to smoking alone. Radon is classified as a Group 1 human carcinogen and is considered by the World Health Organisation as being responsible for between 3 and 14% of lung cancers. An important component of a national strategy to reduce public exposure to radon is risk communication. Its main objectives are to raise awareness of the hazard from radon and to encourage radon measurement in homes and to take action to reduce indoor radon concentrations. Here an overview is given of the various components of radon risk communication such as the identification of target audiences, the messages to be used and the appropriate channels of communication.

1. Introduction

We live all our lives in a radiation environment. Averaged over the world population, excluding exposures due to radiation accidents and the high doses received in radiation therapy, the annual effective dose received from all sources has been estimated by UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation) as 2.8 mSv[1]. UNSCEAR has calculated that this dose is dominated by natural sources such as cosmic radiation, naturally occurring radionuclides like Potassium 40 and Carbon 14 in food and indoor radon(Radon 222). The global mean dose from such natural sources is estimated to be 2.4 mSv/year or 85% of total. The largest component (~ 50%) of the natural doses arises from exposure to radon in homes. Radon exposures are also the most variable. Due principally to geological and house construction/usage factors average indoor radon concentrations have been found to be low in the range 15-30 Bq/m^3 for some countries (eg Japan, the Netherlands and the UK) and to be high in the range 110 - 140 Bq/m^3 for some others (eg the Czech Republic and Finland). Large scale surveys of indoor radon concentrations have shown them to be approximately log-normal. Individual houses with radon concentrations as high as 50000 Bq/m^3 have, however, been found in some countries[2]. At the level of an individual the annual effective dose due to exposure to radon and its progeny will depend on physiological factors, the size distribution of radon progeny etc[3]. For purposes of radiological protection of the population, however, exposure to radon in homes at a concentration of 30 Bq/m^3 is now generally considered as giving rise to an annual

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effective dose of 1 mSv[4].

Radon was classified in 1988 by IARC International Agency for Research on Cancer) as a Group 1 human carcinogen[5]. More recently on the basis of residential epidemiological evidence it has been estimated that exposure to radon may be implicated in approximately 20000 deaths from lung cancer each year in EU Member States[6, 7]. Radon risk is considered by the WHO (World Health Organisation) to be a globally serious public health issue[4, 8]. It is currently estimated by the WHO that the proportion of lung cancers attributable to radon range from about 3 to 14%. Such estimates depend on the average radon concentration in a country as well as the calculation methods used. To reduce the public health burden from radon in a country an integrated radon control strategy is required. There are many components that such a strategy should contain such as first carrying out a representative national indoor radon survey to determine and assess the extent of the radon problem in a country. Both the WHO International Radon Project and the current European Commission RADPAR (Radon Prevention and Remediation) project consider that radon risk communication directed both at the public and also at decision makers at local and national level should be an important component of a national radon control strategy[4, 9].

2. Principles of risk communication

Risk communication should be a two-way exchange of information between those communicating information on the risk and those that may be at risk. If the purpose of risk communication is to reduce the risk to those exposed the disseminated information should not only be informative but should wherever possible be prescriptive emphasising solutions and encouraging action. Irrespective of the type of risk involved there are a number of basic principles or rules that should be followed if risk communication is to be effective. The best known set of these rules are the Seven Cardinal Rules for Effective Risk Communication proposed in 1988 as part of the USEPA approach to risk communication[10]. The most recent version of them published in November 2011 shows that they have remained essentially unchanged for over 30 years[11]. They are as follows :

1. People have the right to have a voice and participate in decisions that affect their lives.
2. Plan and tailor risk communication strategies.
3. Listen to your audience.
4. Be honest and transparent.
5. Coordinate and collaborate with credible sources of information and trusted voices.
6. Plan for media influence.
7. Speak clearly and with compassion.

Central to these rules is the principle that the rights and viewpoints of those likely to be at risk should be respected. It is, however, clear from the way risk communication was handled by the various authorities in the aftermath of nuclear power plant accidents at Three Mile Island, Chernobyl and more recently at Fukushima that full application of these rules was not in evidence. The many confusing statements released directly to the public from regulatory agencies, power companies and the media in the aftermath of these accidents show clearly the need for a radical rethink of communication methodologies to be used in any such accidents in the future. The establishment of trust with target audiences is most important. *The public needs to know that risk communicators care before they care about what the communicators wish to tell them.*

3. Radon risk communication strategies

In keeping with other public health risk communication programmes in communicating radon risk information to the general public (or to policy and decision makers) it is important to have achievable and clear objectives. These should be focused on informing and persuading different target audiences to take action on radon in homes. The two most effective actions for households are to measure the radon concentration and to remediate where necessary. Unlike radiation emergencies where prompt action may be required evacuation from a high radon home is an action rarely considered necessary.

For the communication of radiation risks to the public and decision makers to be effective it should be a cooperative effort involving both technical experts such as radiation scientists and epidemiologists and also communication experts like social scientists, psychologists, journalists etc.

There are in general two main objectives in a radon risk communication programme :

(a) to give accurate and comprehensible information in clear and simple messages on the potential harm to health from radon exposure.

(b) to stimulate the target audiences to take action to measure radon in the home and where necessary to take action to reduce the indoor concentration of radon.

In existing homes with a radon problem there are a range of relatively inexpensive modifications to the building (such as the installation of a radon sump) that can be applied. For future buildings radon preventative technology can be applied to ensure that the radon level in the building will be below a chosen reference level. Radon reference levels in many countries are in the range 100-300 Bq/m^3 [4].

Interactive risk communication involving two-way communication pathways have been found to be generally more effective than one-way communication. Such two-way communication in the case of radon can be achieved by the use of Roadshows, Radon Forums etc. Unlike the case of other environmental and radiation hazards there exists public apathy in accepting that exposure to radon can be a serious health hazard and that effective relatively low-cost technical solutions exist to reduce radon exposures. The reasons for such apathy are many.

Indoor radon exposure is usually perceived as completely natural with no one to blame. It can be argued, however, that this perception of indoor radon exposures as being

natural is erroneous. The source of radon ultimately is radium-226 in rocks and soils and as such is natural but indoor radon exposures can be considered as artificial. Indoor radon levels are artificial as they are the consequence of the human activities of building design, construction and usage. High indoor radon can therefore be justifiably categorised as a form of TENR (Technologically Enhanced Natural Radiation). As radon is colourless, odourless, tasteless and does not seem to cause any obvious health effects radon exposure is low on the perceived scale of concern for the public. This is in strong contrast to public attitudes to CO (Carbon Monoxide). CO is also colourless, odourless and tasteless but for this gas short term exposure to high levels can result in almost immediate death. Such deaths are well documented in the media which helps to heighten public awareness and acceptance that strong action against this hazard is necessary. In the case of radon there are no obvious "dead bodies" and the lung cancer caused by radon exposure, if it occurs, will be many years in the future. In the case of death caused by CO this can be confirmed by the presence of high levels of carboxyhemoglobin (COHb) in the blood of the victim. No such unequivocal marker for a lung cancer death due to radon exposure has so far been identified.

It is of interest to compare the public attitude to radon exposure with their attitude to artificial radiation exposures. The risks from small doses arising from artificial radionuclides in the environment are often magnified in the public perception while much greater doses from radon and its progeny are rarely perceived as a matter of concern. The reasons for this irrational attitude are many and complex[12, 13].

The damage by an alpha particle emitted by a Plutonium atom deposited in the lung traversing a basal cell in the bronchial epithelium is essentially no different from that caused by an alpha particle of similar energy emitted by a Polonium atom, which is a radon progeny, deposited in the lung. Because of the association of Plutonium in the public mind with nuclear weapons any such equality of effect will not be perceived or accepted. In this context it should be noted that a principle of toxicology, first enunciated by Paracelsus, is that "*all things are poisonous and nothing is without poison,only the dose permits something not to be poisonous*" or more commonly "*the dose makes the poison*". Applied to radiation the former of these statements could almost be read as advocating the existence of a threshold effect. It is of interest also to note that Paracelsus in 1531 first drew attention to a high incidence of a fatal lung disease in silver miners in Saxony and Bohemia which he called "mala metallorum" or the disease of metals. We now know in retrospect that what he was describing was lung cancer due to radon exposure.

The actual radon risk communication strategy chosen for a country will depend on a number of factors such as the extent of the radon problem in that country (if it is known), the present state of public knowledge of radon, the available budget, the existence or otherwise of national radon reference levels and national building codes targeted at radon prevention.. Having regard to the variability of these factors on a country to country basis it cannot be expected that a single radon risk communication strategy will be equally effective or applicable in all countries. Even in countries with well developed radon control strategies radon risk communication activities have often evolved in a heuristic fashion having been stimulated by the accidental discovery of high radon dwellings.

Apart from the general public (especially home owners) elected representatives (politicians) and other decision makers should be key target audiences. In particular this could be important at local government (municipality) level where, in many countries, decisions on planning and house construction could include specifications aimed at prevention of high radon levels in future housing. Where decision makers at local government level have a responsibility for ensuring healthy living conditions in homes under their control (i.e public housing) they should be a target audience to encourage a programme of radon measurement and remediation where necessary. Targeting radon information at locally elected representative has also been found to be quite effective at stimulating action against radon. Reducing the radon lung cancer risk can be achieved in a variety ways such as reducing radon exposure in existing houses by radon mitigation techniques or by constructing new houses with effective radon preventative technologies installed[4]. Important roles in encouraging these activities can be played by both regulatory and financial bodies. In the case of the former the introduction of building codes incorporating radon entry prevention technologies and the use of reference levels for indoor radon concentrations (either voluntary or mandatory) can be effective instruments in reducing radon exposure. In the case of the financial bodies, such as banks and mortgage providers, the granting of loans or mortgages for real estate transactions could be conditional on having the radon concentration in a dwelling being below a specified level such as a national reference level.

A group that should be considered as a target audience for radon risk information are smokers. Due to the scientifically established strong synergism between radon exposure and smoking if smokers can be persuaded to reduce their residential radon exposure, even without a cessation or reduction in smoking, a substantial reduction in their overall lung cancer risk might result[6, 8]. While there are some current epidemiological studies into a possible association between childhood leukaemia and radon exposure the principal scientifically verified health hazard of radon exposure is lung cancer. The epidemiological evidence is convincing that a synergism exists between smoking and radon exposure. It is important therefore to highlight this in risk communication campaigns.

4. Messages on radon risk

A number of simple core messages, preferably non-

quantitative, on radon risk and its control should be established and used in all communication campaigns. The following list of radon risk core messages given in the WHO Handbook on Indoor Radon 2009[4] are good examples of these:

(a) Radon is a radioactive gas present in homes.
(b) Radon causes lung cancer.
(c) Radon is easy to measure.
(d) You can easily protect your family from radon.

Messages (a) and (b) in a simple way inform the public that there is a health risk from radon in their homes. Further non-core messages can elaborate on these by informing the public of such facts that radon is natural, where it comes from, how it may enter and accumulate in indoor spaces, that the risk increases with the radon concentration and duration of exposure, that the combined effects of smoking and radon exposure are much greater than simply adding the individual risks etc etc.

Messages (c) and (d) are meant to stimulate action against radon by pointing out it is easy to measure radon in homes and to protect against it. Experience gained by the USEPA shows that putting emphasis on protecting the family from health hazards is much more effective in encouraging action against the hazard than emphasising protecting oneself.

In communicating with smokers, who typically constitute about 30% of the population in many developed countries, targeted messages such as the following might be used to encourage smokers at least to reduce their radon exposure or preferably their smoking.

"Radon increases the already high risk of lung cancer in smokers, but whether you smoke or not radon exposure increases your lung cancer risk".

5. Communication channels

Within the context of a national radon strategy some or all of the following communication channels should be considered. For a basic information platform, websites and information brochures should be provided. Articles placed in health related magazines are considered an effective channel. The mailing of information brochures, advertising in newspapers and magazines, radon phone-in helplines, stands at public events and construction trade exhibitions, press releases, radio and TV popular science programmes etc. can also be recommended. Trained radon mitigators and other construction professionals can play an important role as secondary channels of communication.

Radon Focus Groups and attention to regional characteristics should be used to assess and improve communication effectiveness. Focus Groups are where discussions with and interviews of a representative selection of the public take place on the effectiveness of a risk communication campaign. In the case of radon this typically would take place in a region where high radon concentrations had been found. All aspects of the campaign can be discussed such as an evaluation of information on radon given in brochures, posters, help lines etc. An important objective of a focus group is to try to determine the barriers that exist in the minds of the public in regard to carrying out a radon measurement and taking remedial action in their homes when it is recommended. In addition possible measures to reduce radon must be adapted to the local circumstances.

It is of considerable assistance if dissemination of radon risk information is endorsed by well known health and environmental agencies operating both at a national and regional level.

This recommendation of endorsement by other agencies is aimed at improving the credibility of the disseminated information as quite often while the public may know and trust their local health agency they may not have such opinions (or indeed any opinions) regarding the credibility of the central government agency responsible for radiation protection. At its simplest level this endorsement could take the form of having the logos of such agencies on all radon information brochures etc issued by the central government agency. Stronger forms of such endorsement should be considered such as having speakers from these other agencies at local and national Radon Forums.

If possible radon information campaigns should be linked to other health or environmental campaigns. One possibility are public health information campaigns which are aimed at reducing smoking and at improving indoor air quality. It would therefore appear sensible for policies and strategies aimed at the control of indoor radon exposure to be linked to public health initiatives aimed at reducing risks from the inhalation of other indoor airborne pollutants. Professional marketing companies are likely to have more success in overcoming public apathy towards the radon problem and in motivating action against it than are professional scientists.

Establishing links with respected individuals in professional groups (such as medical, teaching and the construction industry representative bodies) and also with the media is important. Keeping these individuals and groups informed and educated on developments in the radon field (epidemiology, preventative and remediation construction technologies, reference and action level recommendations and legislation) should in effect help to form an additional channel of communication and approval for a national radon control strategy.

Information campaigns on radon, whether directed at the public or decision makers, should be regularly assessed and repeated (again and again and again …) over many years.

6. Assessing effectiveness

Comparing the results of radon awareness surveys of target audiences carried out before and after a communication campaign is a metric that can be used to assess its effectiveness in raising awareness. The effectiveness of a communication campaign directed at the public in stimulating action against radon can be measured by the number of households that volunteer to have their radon concentration measured and most importantly the number of those found to have high

radon concentrations who take action to remediate their homes against radon. Recent studies in the author's country (Ireland) have shown that for dwellings found to be above (and many times above) the national reference level of 200 Bq/m^3 only approximately 25% of such households remediated their home[14]. Other European Union countries have reported a similar finding. The cost of remediation and the disruption remediation work would cause were important factors in this low rate of remediation. It is considered, however, that this rate could be improved by more effective risk communication. In the case of decision makers the effectiveness of a communication campaign directed at them may be measured mainly by such metrics as the introduction of national radon reference levels, changes in building construction codes to ensure that radon concentrations in future buildings (dwellings, schools, workplaces etc) will be below the appropriate national radon reference levels and the introduction by the authorities of financial assistance for high radon households to remediate.

7. Conclusion

It is considered that radon risk communication in its various forms should be an essential component of national radon control strategies. Because radon is colourless, odourless and natural and its health effects only appear after many years of exposure there exists considerable apathy in the minds of both the public and decision makers against taking effective action to reduce the risks from radon. Improved radon risk communication together with government financial assistance and legislative changes are needed to reduce the public health risk from radon.

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References

1. UNSCEAR 2000 Report. www.unscear.org/unscear/publications/2000_2.html
2. Mc Laughlin J.P.,Kelleher K, Jiménez-Nápoles H and León-Vintró L (2005). "Retrospective Radon Assessments in a high Radon House in Ireland", 399-400. High Levels of Radiation and Radon Areas: Radiation Dose and Health Effects. Interna-tional Congress Series Number 1276. ISBN: 0-444-51431-7, Elsevier.
3. ICRP (International Commission on Radiological Protection) (1994) "Human Respiratory Tract Model of Radiolological Protection" ICRP Publication 66, Ann.ICRP 24(1-3).
4. WHO (World Health Organisation) (2009) "WHO Handbook on Indoor Radon", pp94, ISBN (978 92 4 154767-3, Geneva.
5. IARC (International Agency for Research on Cancer) (1988) "Man-Made Mineral Fibres and Radon" Monograph Series Volume 43, 300pp, ISBN 9283212436.
6. Darby S, et al (2005) "Radon in homes and risk of lung cancer: collaborative analysis of individual data from 13 European case-control studies", British Medical Journal, Vol 330, 223.
7. Mc Laughlin J.P. and Bochicchio F.(2007) "Radon and Lung Cancer" Proceedings of 1st EnVie Conference, 199-210, Helsinki. (www.envie-iaq.eu)
8. WHO Guidelines for Indoor Air Quality : selected pollutants. (2010) Chapter 7 Radon, 347-369, WHO Regional Office for Europe, Copenhagen.
9. European Commission RADPAR Project (web.jrc.ec.europa.eu/radpar/)
10. Covello V.T. and Allen F (1988) "Seven Cardinal Rules of Risk Communication". Washington D.C. : US Environmental Protection Agency.
11. Covello V.T. (2011) "Risk Communication, Radiation, and Radiological Emergencies: Strategies, Tools and Techniques" Health Physics, Volume 101 (5), 511-530.
12. Guimond R.J. and Page S.D. (1992) "Indoor Radon : A Case Study in Risk Communication" Radiation Protection Dosimetry, Volume 42(3), 169-176 .
13. Lee T.R. (1992) "The Public's Perception of Radon" Radiation Protection Dosimetry, Volume 42(3), 257-262.
14. RPII (Radiological Protection Institute of Ireland) Radon Forums, see website : www.rpii.ie