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Evaluation and equity audit of the domestic radon programme in England

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ABSTRACT

The UK has a radon programme to limit the radon risk to health. This involves advice on protective measures in new buildings, technical guidance on their installation, encouragement of radon measurements and remediation in existing dwellings in high radon areas. We have audited the radon programme at the level of individual homes to identify factors that influence the likelihood of remediation. 49% of the householders responded to our survey and 30% of the respondents stated that they had done some remediation to reduce the indoor radon levels. We found that householders with higher incomes and higher socio-economic status are more likely than others to remediate. Householders are less likely to remediate if they have one of the following: living in a property with a high radon concentration, current smokers in the dwelling, being unemployed or an unskilled worker, long length of time living in that property or elderly (65+ years) living by themselves. Householders appeared to be more likely to remediate if they considered the information on radon and its risk to be very clear and useful. This emphasises the importance of communication with householders.

1. Introduction

1.1. Health risks of radon

The detrimental effects of exposure to high radon levels were first observed in 16th century silver miners in central Europe as high levels of fatal lung disease, identified as lung cancer in 20th century. Many epidemiological studies of miners in different parts of the world have demonstrated that an increased level of radon gas results in a statistically significant increase in the risk of lung cancer (BEIR VI). Domestic case–control studies have linked radon and lung cancer in, for example, Sweden and England [1,2]. These studies showed that the risks from exposure to elevated levels of radon in the home were consistent with the outcomes of previous studies on miners, who were occupationally exposed to radon. Studies have consistently shown an increased relative risk of lung cancer with radon exposure for both smokers and non-smokers: the consequence is that the absolute risk of lung cancer is far higher in smokers due to the greater base-line risk. International pooling studies in Europe, North America and a further study in China, have now demonstrated and quantified more precisely than before, the risks from exposure to radon in the domestic situation [3–5]. An in-depth review of the health effects of radon exposure by the independent Advisory Group on Ionising Radiation to the Health Protection Agency was published recently [6].

1.2. UK control strategy and radon programmes

This strategy involves protective measures in new buildings and radon measurements and encouragement of

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remediation in existing dwellings in high radon areas. In January 1990, the National Radiological Protection Board (NRPB, now part of the Centre for Radiation, Chemical and Environmental Hazards of the Health Protection Agency, HPA) published the principles underpinning the advice to Government on the limitation of human exposure to radon in homes [7]. A supporting document explored the practical implications and provided numerical limits [8]. It included a recommended Action Level for radon in existing homes in the UK of 200 Bq m^{-3} averaged over a year. It also proposed that parts of the country with 1% probability or more of present or future homes being above the Action Level should be regarded as Radon Affected Areas and that appropriate authorities should delimit localities where precautions against radon should be installed in future homes.

Approved Document part C, issued in support of the Building Regulations, refers to guidance on these localities [9]. This guidance, which includes the technical details of the radon protective measures for new buildings, extensions, conversions and refurbishments, is published by the Building Research Establishment [10]. More recently, HPA has recommended to Government that basic protection measures should be installed in all new buildings [11] and, earlier this year, published updated advice on the limitation of human exposure to radon which took account of the new epidemiological data and more recent international advice [12]. The Action Level remains unchanged, the recommendation that basic protection measures should be installed in all new buildings is re-iterated and a Target Level of 100 Bq m^{-3} introduced for protective measures in new build and remedial measures in existing buildings.

The highest risks are in homes with highest radon levels, although it should be noted that most cases of radon induced lung cancer will occur in residents of homes with low or average levels due to the much larger number of such dwellings. It is not possible to predict the radon level in an individual dwelling and radon levels vary significantly between neighbouring and even adjoining properties. A key element to identifying which homes pose the greatest risk to the occupants is the development of radon maps showing the probability that an individual dwelling will exceed the Action Level. These maps are used to guide radon measurement programmes.

The first radon map for part of the United Kingdom (UK) was published in 1990. The current UK radon maps consist of a joint map for England and Wales, and separate maps for Scotland and Northern Ireland. The map for England and Wales was published in 2007 [40] and those for Scotland and Northern Ireland in 2009 [35,36]. The radon programme, with the overall objective of reducing the radiation doses from radon by identifying homes at or above the Action Level and encouraging the householder or landlord to take the appropriate remedial action, was rolled out by Government Departments with responsibility for radon policy throughout the UK to reduce the risk to health [37]. The programme was successful in identifying the homes with high radon levels but the remediation rates were disappointingly low at around 10–20%. A new programme model was rolled out in 2001 [13] and was locally tailored with the local authority acting as the public face, supported by central Government/Devolved Administrations and NRPB.

There have been previous audits and evaluations of the radon programmes in the UK, both nationwide and in defined areas. Lee and MacDonald [14] used a nationwide sample of over 7000 households and found that cost was a clear deterrent to remediation, the elderly and retired paid more attention to the radon issue but remediated less than others and making radon an issue at house sales promoted testing and remediation. Bradley and Thomas [15] also found that cost was a deterrent and reported that 27% of the 5153 responders, out of a sample of 10,174 householders in southwest England, had taken some remedial action and that homes with higher levels of radon were more likely to be remediated. Denman et al. [33,34,21] obtained a 60% response from a sample of 122 homes in Northamptonshire and reported that householders with radon levels just above the Action Level were less likely to carry out remediation work and those who remediated are not representative of the general population: householders who were older, smoked less and had fewer children were more likely to take action. An analysis of the radon programme [16] found that it had resulted in increased awareness among both the public and professionals (councillors, council officers, solicitors, estate agents, surveyors, health professionals, builders). While the rates of testing homes and identifying those with high radon levels were good, the remediation rate was still too low. Since 2005, the HPA has taken over the management of the English domestic radon programme and has evolved the model to take account of many of the findings of these audits.

1.3. Objectives of this audit

This audit evaluated the radon programme at the individual household level to identify the factors associated with householder's willingness to participate in the programme and carry out remediation. The audit also focused on the health equity of the domestic radon programme. The relevant equity question for the radon programme is whether it meets the needs of those most at risk from adverse health effects of radon (e.g. high levels of radon, long exposure, and exposure to cigarette smoke). It is also important to assess inequality in the programme to identify factors that may hinder access to testing and remediation. The information from this paper will help to improve the effectiveness and cost-effectiveness of the radon programme and recommend ways of reducing any inequities or inequalities found.

2. Materials and methods

Questionnaires were sent to all named householders in the national radon database who have a record of a test finding a high radon level (>195 Bq m^{-3}) since 01/01/2000. We included tenants in private housing but excluded tenants in social housing as the responsibility for remediation