Radon and the Family Physician

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Radon is a radioactive gas produced during the natural breakdown (radioactive decay) of uranium. Since uranium is present in many types of rock and soil, radon is found in most communities. When radon percolates from the soil into the atmosphere, it poses little problem because it is rapidly diluted to very low concentrations. If the radon seeps from the soil into an enclosure such as a house, however, it can accumulate to a significant concentration, depending on the seepage rate and the construction features of the house. Radon also can enter a house in well water used for domestic purposes.

Potential health effects of radon are caused not by the gas itself, but by the radioactive products polonium-218 and polonium-214 formed as radon decays with a half-life of 3.8 days. These products attach to surfaces of aerosol, dust, and smoke particles present in room air. As the particles are inhaled, they become lodged deep in the lungs, where they irradiate sensitive cells and tissues. Energy deposited during irradiation is believed to cause cellular changes that lead ultimately to clinically detectable cancer after several years.

Most of the evidence linking radon to lung cancer comes from retrospective studies of miners of uranium and precious metal. Working underground, these miners were exposed to relatively high levels of radon and other airborne carcinogens, and show a higher incidence of lung cancer. Many of them also smoked cigarettes. The risk to home residents who are exposed to lower radon concentrations is estimated by extrapolating the risk level of miners to lower levels of radon. Some experts claim that a straight-line extrapolation may not be appropriate, because a threshold concentration may exist below which no increased risk of lung cancer exists.[1] Others suggest that the carcinogen-rich atmosphere of early mines does not resemble home air containing radon, and that radon at low levels in houses does not constitute a health risk.[2] Most radiation advisory groups,[3–7] however, believe that radon at low concentrations is a health risk, especially for persons who are also exposed to tobacco smoke, which causes as much as a 10-fold increased health risk for this group. The Environmental Protection Agency (EPA) estimates that as many as 20,000 persons may die from lung cancer each year as a consequence of long-term exposure to radon.[6] Although these estimates are currently under intense debate, it is likely that the figure will remain within 20% of the EPA's current estimate (personal communication, M. Culler, EPA, May 1991) and should not alter the recommendation for environmental testing.

Radon is a colorless, odorless, and tasteless gas that is not detectable by the physical senses. It can, however, be measured by special devices such as charcoal canisters, electret ion detectors, and alpha track monitors. These devices are inexpensive (approximately $20) and easy to use, and can be obtained by mail order or from hardware stores and other retail outlets. Devices from a company that have passed the Radon Measurement Proficiency Program of the EPA provide some assurance that measurements obtained with the devices are accurate.[8] When the sample collection has been completed, the devices are returned to the manufacturer for analysis. As an alternative, a radon consulting company can be hired to test a house. A list of companies providing testing services can be obtained from most state environmental protection agencies.

Screening tests to determine whether significant radon concentrations might exist in a building are conducted over a few days with the doors and windows closed. When a screening test indicates that a problem might exist, more accurate tests performed over several months (usually a year) with the building in routine use are recommended. Only the results of the longer term tests should influence a decision to initiate a program to reduce radon levels. Some experts suggest that screening tests can be misleading, and that only the longer term tests should be used. The appropriate response to a high test result depends not only on the extent of exposure to elevated concentrations of radon, but also on the cost and inconvenience of remediation. An older working couple

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who occupy their home only part of each day might be willing to tolerate a higher concentration than would a family with young children who are at home most of the time.[9]

While some regions of the United States have a higher frequency of significant radon concentration than others, the only way to determine whether a particular building or home is affected is by testing. Because screening and subsequent corrective action, where indicated, can completely remove this hazard, universal testing is now advocated by the EPA.[6]

Most recommendations for corrective actions for indoor radon concentrations are based on concentrations of radon expressed in pCi/L. A review of 38 studies involving houses in 21 states concluded that 1.5 pCi/L is the average level of radon in the United States.[10] The agency suggests that remedial measures should be taken for any house with an average annual level above 4 pCi/L, and that such actions should be considered whenever values above the average radon level are obtained.

Radon levels in houses can be reduced by blocking radon entry, reducing radon buildup by improving ventilation, and removing radon and its decay products from the air. Blocking the entry of radon is usually the preferred remedial measure. Sealing cracks and joints in the foundation can help, but often soil ventilation is required to pull radon away before it enters the house. This method, called *soil depressurization*, can usually be installed for less than $2000 in an existing house, and for much less in a house under construction. Increasing ventilation of the house can sometimes help, but care must be taken not to create a "stack effect" that draws more radon into the house.[11] Air cleaners and ion generators attached to fans can sometimes be used to reduce relatively low levels of radon to acceptable levels in specific rooms of a house.[12] Most state environmental protection agencies offer a list of contractors experienced in radon abatement.

Physicians can help patients and the public by placing the radon problem in proper perspective.[13] By addressing patient concerns and speaking out about the public health aspects of radon, they can lend an objectivity that otherwise may be absent. Physicians can ease case anxieties and prevent overreactions, as well as dissuade people from being apathetic about the health risks of radon. Radon is one potential public health problem that individuals can do something about without extensive technical expertise or great expense. Helping the public approach the radon problem rationally and unemotionally could be a major contribution of physicians. Providing patients with appropriate referral to additional sources of information, including state environmental protection agency telephone numbers and a 24-hour toll-free radon hotline (1-800-SOS-RADON), might also be helpful.

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