Lung Cancer Risk From Exposure to Radon in the Home - Are Policies in the U.K. Appropriate to the Risk?

Andrew T. Arthur MPH MCIEH FRSH
Public Health Policies
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- Excess mortality, morbidity and premature death with failure to recognise problem
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- Excess mortality, morbidity and premature death with failure to recognise problem
- Unnecessary expenditure, opportunity costs if risk wrongly attributed or applied
Radon

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- Seeps through soil and can enter buildings
Naturally occurring radioactive gas
Part of decay chain of uranium
Usually associated with hard rock, especially granite
Seeps through soil and can enter buildings

Radon

1 through cracks in solid floors
2 through construction joints
3 through cracks in walls below ground level
4 through gaps in suspended floors
5 through cracks in walls
6 through gaps around service pipes
7 through cavities in walls
Why a Potential Problem?
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- Decays to solid daughter particles, several of which are also alpha emitters
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- Become trapped in airways and can irradiate sensitive lung tissue and cause DNA damage
- Evidence linking it to lung cancer
Lung Cancer
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- Most common form of cancer death in U.K.
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- Most common form of cancer death in U.K.
- Tobacco implicated in vast majority of cases (approx. 90%)
Radon and Lung Cancer
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- Recognised as a problem following cohort studies of miners - excess lung cancer mortality with high level exposures
Radon and Lung Cancer

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- Since 1980’s exposures in certain homes considered potential cause of lung cancer
UK Policy - Radon at Home
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- Remedial action advised where dose equivalent levels => 200 bq m$^{-3}$
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- Survey of radon by NRPB
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- Public awareness campaign
UK Policy - Problems
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So:-
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- Change in policy to target remediation in co-operation with L.A.’S
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Change in policy to target remediation in co-operation with L.A.’S

Introduction of changes to building regulations to require protection in new homes
Evidence Base
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Individual level:
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- Indirect - extrapolation from prospective cohort studies of miners individual level
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- Direct - from retrospective residential case-control studies
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Population level:
Evidence Base

Individual level:
- Indirect - extrapolation from prospective cohort studies of miners individual level
- Direct - from retrospective residential case-control studies

Population level:
- Direct - from ecologic studies of cancer mortality and average radon levels
Problems With the Evidence
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No disagreement that high level exposure carries risk, *but*:
Problems With the Evidence

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- Extrapolation from miner studies assume exposure response curve of LNT theory correct
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- Case control study results inconsistent and do not provide definitive support of excess risk
Problems With the Evidence

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- Extrapolation from miner studies assume exposure response curve of LNT theory correct
- Case control study results inconsistent and do not provide definitive support of excess risk
- Limits to ecologic method
Review of Case-control Studies
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- Inadequacies of sample size and power to resolve risk with precision
Risk Modelling
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U.K. Policy based on:
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U.K. Policy based on:

BEIR VI model which assumes LNT
Outcomes Predicted
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- Current predicted outcomes using this model are for annual lung cancer mortality of between 2000 and 3300
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- Between 500 and 1300 of these are in non-smokers.
Is the Model Correct?
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- What does this mean in practice?
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US lifetime lung cancer mortality attributable to radon in a cohort of 50,000 males and 50,000 females at age 30

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<th>&gt;4</th>
<th>&gt;10</th>
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</tr>
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<tbody>
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<td>No-mobility model</td>
<td>40 (8.7%)</td>
<td>277 (60.5%)</td>
<td>141 (30.8%)</td>
<td>47 (10.3%)</td>
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Other Methodological Issues
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Radon mapping
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- Data may be inaccurate
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Radon control
Other Methodological Issues

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Radon control
- Cost effectiveness modelled on static population
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Radon control
• Cost effectiveness modelled on static population
• Ceasing smoking of considerably more benefit
Policies in Practice
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Assuming model is correct at low doses:

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- Have not compared radon programme costs with other interventions
Recommendations
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- Evaluate and quantify effects of UK population mobility
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- Calculate true costs of remediation allowing for mobility
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- Re-evaluate numbers and locations of homes with high radon levels
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- Calculate true costs of remediation allowing for mobility
- Re-evaluate numbers and locations of homes with high radon levels
- Evaluate costs of radon remediation against smoking cessation