A cost-effectiveness analysis of domestic radon remediation in four primary care trusts located in Northamptonshire, UK
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Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Domestic radon remediation programmes in four primary care trusts (PCTs) located in Northamptonshire, UK, were compared. The PCTs were Cherwell Vale, Daventry & South Northamptonshire, Northampton, and Northamptonshire Heartlands. In operation, the fan extracted radon-rich air and expelled it into the atmosphere. The UK’s National Radiological Protection Board (NRPB) has designated localities where more than 1% of domestic properties have radiation levels over 200 Bq/m3 (Becquerels per cubic metre) as "Affected Areas".

Type of intervention
Secondary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
The population comprised householders in Northamptonshire.

Setting
The setting was primary care. The economic study was carried out in Northamptonshire, UK.

Dates to which data relate
The effectiveness data were gathered from programmes conducted between July 1993 and February 2003. The dates to which the resource use data related were unclear. The price year was 2001.

Source of effectiveness data
The effectiveness data were derived from a data series that was employed in another study (Coskeran et al. 2002, see 'Other Publications of Related Interest' below for bibliographic details). Effectiveness data were also derived from completed studies, augmented by assumptions when necessary.

Outcomes assessed in the review
The outcomes assessed were:

the number of properties remediated,

the percentage of properties above the NRPB Action Level, and

the average pre- and post-remediation levels of exposure to radiation according to PCT.
Study designs and other criteria for inclusion in the review
The number of properties remediated in each PCT was derived from an earlier cost-effectiveness analysis conducted by the authors (Coskeran et al. 2002). In the present study, the authors did not report any details of the method used in the other cost-effectiveness analysis. The study designs of the other primary studies included in the analysis were not reported.

Sources searched to identify primary studies
Not reported.

Criteria used to ensure the validity of primary studies
Not reported.

Methods used to judge relevance and validity, and for extracting data
Not reported.

Number of primary studies included
Three studies were included in the analysis.

Methods of combining primary studies
The results of the primary studies were combined in a narrative.

Investigation of differences between primary studies
Not reported.

Results of the review
The number of remediated properties in each PCT was 20 in Cherwell Vale, 28 in Daventry & South Northamptonshire, 30 in Northampton, and 33 in Northamptonshire Heartlands.

The proportion of properties above the NRPB Action Level was 9.00% in Cherwell Vale, 5.60% in Daventry & South Northamptonshire, 5.10% in Northampton, and 7.76% in Northamptonshire Heartlands.

The average reduction in radiation per household was 440.80 Bq/m³ in Cherwell Vale, 396.46 Bq/m³ in Daventry & South Northamptonshire, 360.77 Bq/m³ in Northampton, and 446.00 Bq/m³ in Northamptonshire Heartlands.

In all four PCTs, the reductions in average readings per household were greater than 80%.

Methods used to derive estimates of effectiveness
The authors made some assumptions to derive estimates of effectiveness.

Estimates of effectiveness and key assumptions
Residents were assumed to have moved between rooms in a manner consistent with the NRPB weighted average radon level.

The proportion of properties in the PCT above the Action Level who actually remediate was assumed to be 10%.
Measure of benefits used in the economic analysis
The outcome measures were the number of life-years gained (LYG) and the number of lung cancers averted. The LYG were assumed to be spread equally across a 40-year period radon remediation, based on the assumption that the remediation undertaken would reduce exposure to radon over this period. The LYG were calculated on the basis of Kennedy's study, which suggested that in Northamptonshire every lung cancer averted produced 13.51 additional life-years (Kennedy et al. 1999, see ‘Other Publications of Related Interest’ for bibliographic details). The health benefits were discounted at annual rates of 3% and 6%.

Direct costs
The resource use quantities and costs were not reported separately. The direct costs included in the analysis were the imputed initial costs of radon measurements, the costs of remediation work, the cost of retesting properties after the remediation work, the cost of operating the fans, and the cost of fan replacement every 10 years. All costs quoted were given in 2001 prices. Values were converted into 2001 prices using the price index series for housing repairs and maintenance charges from the Monthly Digest of Statistics. The costs were estimated from actual data. The costs were discounted at rates of 3% and 6% per annum, and their values reported. The authors reported the total and average discounted costs per property.

Statistical analysis of costs
The costs were treated deterministically. No statistical analysis of the costs was undertaken.

Indirect Costs
The indirect costs were not included in the analysis.

Currency
UK pounds sterling (€).

Sensitivity analysis
The authors stated that the percentage of householders who remediate was subjected to a sensitivity analysis (5, 10, 15, 20 and 25%).

Estimated benefits used in the economic analysis
The total lung cancers averted was 1.184 in Cherwell Vale, 1.988 in Daventry & South Northamptonshire, 1.717 in Northampton, and 2.706 in Northamptonshire Heartlands.

The total undiscounted (discounted 3%; discounted 6%) LYG were:

- for Cherwell Vale, 15.998 (9.522; 6.379);
- for Daventry & South Northamptonshire, 26.851 (15.982; 10.706);
- for Northampton, 23.201 (13.810; 9.251); and

Cost results
The total costs discounted at an annual rate of 3% (discounted 6%) were:

- for Cherwell Vale, 116,742 (107,210);
for Daventry & South Northamptonshire, 203,818 (190,473);
for Northampton, 233,105 (218,806); and
for Northamptonshire Heartlands, 195,858 (180,130).
The average total costs per property discounted at an annual rate of 3% (discounted 6%) were:
for Cherwell Vale, 5,387 (5,360);
for Daventry & South Northamptonshire, 7,279 (6,803);
for Northampton, 7,770 (7,294); and
for Northamptonshire Heartlands, 5,935 (5,458).

**Synthesis of costs and benefits**
The cost per lung cancer averted was not calculated.
The cost per LYG using a discount rate of 3% (6%) was:
for Cherwell Vale, 12,260 (15,148);
for Daventry & South Northamptonshire, 12,753 (17,791);
for Northampton, 16,880 (23,652); and
for Northamptonshire Heartlands, 9,002 (12,358).

In the sensitivity analysis, when varying the percentage of householders remediated between 10 and 25%, the relative order of the PCT did not change. The remediation programmes in all PCTs were cost-effective under the Gerber-Phelps criterion or the recommend threshold of the National Institute for Clinical Excellence (a 30,000 cut-off point).

**Authors’ conclusions**
The remediation programmes in the primary care trusts (PCTs) were cost-effective. Tackling radon remediation would, on average, be more cost-effective in Northamptonshire Heartlands PCT than in Northampton PCT. However, even in Northampton there is a case for seeing radon remediation as cost-effective.

**CRD COMMENTARY - Selection of comparators**
The authors did not clearly justify the comparators used. They used data from an earlier study that questioned the cost-effectiveness of radon remediation within certain parts of Northamptonshire. The authors did not provide a full report of the remediation programmes conducted in each PCT. You should consider whether the remediation programmes, as reported by the authors, reflect widely used interventions in your own setting.

**Validity of estimate of measure of effectiveness**
The authors’ earlier cost-effectiveness study provided the main data used to estimate the outcomes. However, the authors only provided brief details of this prior analysis, so the validity of the data cannot be assessed without looking at the study in further detail (Coskeran et al. 2002). The authors also used data from other studies selectively to estimate outcomes. However, they only provided brief details of these studies.

A systematic review of the literature was not undertaken to identify all relevant research and minimise biases. Uncertainty around all outcomes was not evaluated in a sensitivity analysis. A sensitivity analysis was only conducted on
the percentage of householders who remediate. The values used in the sensitivity analysis were not justified with reference to the literature. Given the lack of reporting on the identification and selection of included data, it was not possible to ascertain whether the best available evidence had been used to conduct the analysis.

Validity of estimate of measure of benefit
The authors used lung cancers averted and LYG as measures of health benefits. The estimation of benefits was assessed over 40 years, but this choice was not justified with reference to the literature. The benefits were estimated from a published study and through assumptions. A model was not used to estimate the long-term benefits.

Validity of estimate of costs
The perspective of the analysis was not explicitly stated, thus it is not possible to say whether all the relevant costs were included. When considering the perspectives of the National Health Service or society, the cost of visits to the general practitioner and the costs of treated lung cancer should be included in the analysis. In addition, the costs involved in the absence of remediation programmes were not included in the analysis. This omission would affect the results (overestimation of the cost-effectiveness ratios). The costs and the quantities were not reported separately, which will limit the generalisability of the authors' results. The cost data were taken from actual data. No sensitivity analysis on either resource use or prices was conducted. This limits the interpretation of the results. The price year was reported, which will aid any possible future inflation exercises. Since the costs were incurred during more than 2 years, the future costs were appropriately discounted.

Other issues
The authors made appropriate comparisons of their results with those from other studies, showing that radon remediation was relatively cost-effective when compared with other interventions. The issue of generalisability to other settings was not directly addressed, although it was partially explored through the sensitivity analyses. The authors’ conclusions reflect the scope of the analysis. The only "limitation" stated by the authors was that the sensitivity analysis did not consider the cost of programmes that would be required to encourage more households to remediate.

Implications of the study
The authors suggested that subsequent policy recommendations for PCTs should included actions to encourage remediation among their populations and to identify those most at risk from the effects of radon.

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Other publications of related interest

Kennedy CA, Gray AM, Denman AR, Phillips PS. A cost effectiveness analysis of a residential radon remediation

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