The cost-effectiveness of radon-proof membranes in new homes: a case study from Brixworth, 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
The study examined the use of radon-proof membranes in new homes.

Type of intervention
Primary prevention.

Economic study type
Cost-utility analysis.

Study population
The study population comprised individuals living in areas at risk of radon exposure.

Setting
The setting was the community. The economic study was carried out in the UK.

Dates to which data relate
The effectiveness data were derived from studies published between 1993 and 2005. The resource use and cost data were derived from a study published in 2005. The price year might have been 2004, but this was not stated clearly.

Source of effectiveness data
The clinical data used in the economic evaluation were:

- the radon levels in houses with and without membranes,
- reduced exposure to radiation as a result of the membranes,
- lung cancers averted,
- the number of occupants in each property,
- the extra life-years due to averted cancer.

Sources searched to identify primary studies
Clinical data were derived from published studies and authors' opinions. Radon levels in houses with membranes were derived from a study carried out between December 2003 and May 2004 in 65 properties in the area of Brixworth. In each house, two track-etch detectors were placed in the home for 3 months, one in the master bedroom and one in the living room. Radon levels in houses without membranes were derived from published evidence supported by authors'
opinions. Reduced exposure to radiation as a result of the membranes came from a calculation based on the UK Health and Safety Commission. The number of occupants in each property was obtained from the 2001 UK Population Census. The sources of the other data were not fully described.

**Methods used to judge relevance and validity, and for extracting data**
The primary studies appear to have been identified selectively and no systematic search for data was reported. The authors obtained the efficacy of membranes in reducing radon levels from the results of radon levels found in the 65 Brixworth properties. The other data were mainly obtained from UK sources.

**Measure of benefits used in the economic analysis**
The summary benefit measure used was the quality-adjusted life-years (QALYs). These were obtained by combining survival and improvements in quality of life (QoL) from the use of membranes. QoL estimates were derived using the published EuroQol EQ-5D. The QALYs were discounted at an annual rate of 3%. Lung cancers averted and life-years gained were also reported.

**Direct costs**
The viewpoint of the analysis was not stated, but only the cost of installing radon-proof membranes was considered. The costs of the comparator (no membranes) were implicitly assumed to have been nil. Thus, the costs associated with treatment of potential cancers averted were not included. A breakdown of the cost items was not given. Data on the costs were derived from the Brixworth study. The costs were not discounted, which was appropriate given the short time horizon of the cost analysis. The price year was not explicitly reported, but it might have been 2004.

**Statistical analysis of costs**
The costs were treated deterministically.

**Indirect Costs**
Productivity costs were not considered.

**Currency**
UK pounds sterling ( ).

**Sensitivity analysis**
A deterministic sensitivity analysis was carried out to assess the robustness of the cost-utility ratios to variations in some assumptions. For example, the number of residents per household, average occupancy, effect of membranes, period over which the QALYs were spread, discount rate, QoL estimates, and life-years experienced without installing membranes. Alternative values were often derived from other published sources. A log-normal distribution was assigned to radon levels without membrane protection. One thousand replicates were made to obtain mean estimates and standard deviation around the means.

**Estimated benefits used in the economic analysis**
Over a 40-year period, the lung cancers averted were 0.2242 and the total life-years gained were 3.2991 (discounted 1.9637).

The QALYs were 5,960.9862 with no membranes installed and 5,966.4268 with membranes installed (difference 5.4766).

The discounted QALYs gained from installing membranes were 3.2597.
Cost results
The cost of installing radon-proof membranes in 65 properties was 20,150.

Synthesis of costs and benefits
An incremental cost-utility ratio was calculated in order to combine the costs and benefits of the alternative strategies.

Under base-case conditions, the incremental cost per QALY gained with radon-proof membrane installation in comparison with no intervention was 6,182.

The cost per QALY ranged from 1,893 in the best-case scenario to 56,531 in the worst-case scenario. However, in general, the incremental cost per QALY was between approximately 5,000 and 10,000. The impact of individual assumptions was extensively reported.

Authors’ conclusions
The use of radon-proof membranes in new properties was cost-effective in addressing the dangers to health posed by radon in comparison with no intervention.

CRD COMMENTARY - Selection of comparators
The selection of the comparator was appropriate in that no installation of radon-proof membranes was the alternative strategy. You should decide whether these are valid comparators in your own setting.

Validity of estimate of measure of effectiveness
The clinical data were mainly derived from the literature. However, the authors did not report any criteria for a systematic search of the literature, which suggests that the studies used were selectively identified. Some information on the primary sources was reported, especially with respect to the Brixworth study. Other data came from national statistics. The impact of using different sources of data was extensively investigated in the sensitivity analysis.

Validity of estimate of measure of benefit
QALYs were an appropriate benefit measure given the impact of the disease on both survival and QoL. In effect, these are the two most relevant dimensions of health for patients exposed to radon. Discounting was performed, as recommended by UK guidelines. Alternative discount rates were used in the sensitivity analysis. The approach used to derive QoL estimates was extensively described and the authors justified the choice of some values.

Validity of estimate of costs
The cost analysis represented a minor part of this economic evaluation, and only the costs of membrane installation were included. The authors did not consider other costs such as the direct medical costs avoided because of a reduction in the number of lung cancers. The costs were derived from a study carried out in the UK. The price year was implicitly reported. The use of alternative cost estimates was not considered.

Other issues
The authors made explicit comparisons with the cost-effectiveness of other interventions that had been funded in the UK, and showed that the use of radon-proof membranes in new properties was highly cost-effective. However, it was stated that few studies had investigated the cost-effectiveness of membrane installation in new houses. The extensive sensitivity analysis improved the external validity of the study, although the issue of the generalisability of the study results to other settings was not explicitly addressed. The relatively high utility estimates associated with cancer and the exclusion of the future cost of cancer treatment appear to have been conservative factors and, in reality, membrane installation may be even more cost-effective.
Implications of the study
The study results support the installation of radon-proof membranes in new properties. The authors stated that further research should evaluate whether the extra costs of a more rigorous building inspection regime would reduce the cost-effectiveness of the intervention.

Source of funding
None stated.

Bibliographic details

PubMedID
16854498

DOI
10.1016/j.healthpol.2006.06.005

Other publications of related interest
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Indexing Status
Subject indexing assigned by NLM

MeSH
Cost-Benefit Analysis; England; Environmental Exposure /legislation & jurisprudence /prevention & control; Facility Design and Construction /economics; Housing /economics; Humans; Radon

AccessionNumber
22007008154

Date bibliographic record published
31/10/2007

Date abstract record published
31/10/2007