The cost effectiveness of radon mitigation in existing German dwellings: a decision theoretic analysis

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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.

CRD summary
The aim was to assess the cost-effectiveness of policy options for screening for and reduction of radon in German dwellings. The author concluded that regulations with mandatory screening and mitigation for indoor radon levels of 100 Becquerels per cubic metre were cost-effective. The methods and reporting of the study were satisfactory and the results appear to be reliable.

Type of economic evaluation
Cost-effectiveness analysis, cost-utility analysis

Study objective
The aim was to assess the cost-effectiveness of policy options for the screening and removal of radon in German dwellings.

Interventions
The interventions were the screening and alleviation of radon through draft laws, guidelines, and regulations. Universal screening and mandatory mitigation was compared with universal screening and optional mitigation, and optional screening and mitigation. Each scenario considered radon levels of 100, 200, and 400 Becquerels (Bq) per square metre, at which mitigation was considered.

Location/setting
Germany/primary health care.

Methods
Analytical approach:
A decision analytic model was used to combine the costs and effectiveness data from a number of published studies. The time horizon was 40 years and the author stated that the perspective was societal.

Effectiveness data:
The effectiveness data came from published literature and were identified by an extensive search. The main sources were controlled observational studies, and the epidemiological data were from a surveillance centre (German Cancer Research Centre). The main clinical effectiveness estimates were the incidence of lung cancer and the relative risk of it with radon exposure.

Monetary benefit and utility valuations:
The utility estimates were from a number of published European studies, which used the visual analogue scale to derive them.

Measure of benefit:
The measure of benefit was the number of quality-adjusted life-years (QALYs), which were discounted at a rate of 1.5% per annum. Life-years gained and cases of lung cancer averted were reported.

Cost data:
The direct costs included the in-patient treatment of lung cancer, rehabilitation, and out-patient drug prescriptions,
while the indirect costs included lost productivity; the costs of radon removal were included. The cost data came from published studies, for the treatment of lung cancer, and government agency reports, such as those of the Action Programme Environment and Health (APUG). All costs were adjusted to 2008 values, using the consumer price index from the Federal Statistical Office, and presented in Euros (EUR). They were discounted at a rate of 3% per annum.

Analysis of uncertainty:
One-way sensitivity analyses were performed, for all the main model parameters. Probabilistic sensitivity analysis was performed and the results were presented in a cost-effectiveness acceptability curve and a cost-effectiveness acceptability frontier.

Results
At an action level of 100Bq per cubic metre, the total net costs of universal screening and mandatory mitigation were EUR 2.66 billion compared with EUR 1.20 billion for universal screening and optional mitigation, and EUR 71 million for optional screening and mitigation. The QALY gains were 105,521 with universal screening and mandatory mitigation, 4,013 with universal screening and optional mitigation, and 138 with optional screening and mitigation.

The cost per QALY gained was EUR 25,181 for universal screening and mandatory mitigation, EUR 299,091 for universal screening and optional mitigation, and EUR 516,194 for optional screening and mitigation, at an action level of 100Bq per cubic metre. Increasing the action level increased the cost per QALY gained.

The one-way sensitivity analyses showed that altering the inputs had a significant effect, particularly when the relative risk of lung cancer with radon exposure was altered. The probabilistic sensitivity analysis showed that maintaining the status quo (no intervention) had the highest probability of being the best strategy. Universal screening and mandatory mitigation had the highest expected value, when comparing the net benefits of the strategies, at a willingness to pay over EUR 25,181 per QALY.

Authors' conclusions
The author concluded that regulations with mandatory screening and mitigation for indoor radon levels of 100Bq per cubic metre were cost-effective.

CRD commentary
Interventions:
The interventions were well described and were realistic regulatory options within the study setting. They appear to have been appropriate comparators.

Effectiveness/benefits:
The effectiveness data were from multiple published sources. The author described these sources sufficiently and provided their references. The methods of the literature review were not provided, but the author stated that the search strategies were available on request. From the information given, it is unclear whether the best available evidence was used. The author referred to the European Quality of life (EQ-5D) questionnaire as a source of utility estimates, but the estimates were based on the visual analogue scale, which might not have been sufficient. The measure of benefit was appropriately discounted.

Costs:
The author reported the perspective and appears to have included all the costs relevant to this societal perspective. The costs were also relevant to the study population and setting. The author adjusted them to a base year, using the consumer price index, but adjustment using the health care component of the consumer price index might have been more appropriate, as health care inflation exceeds that of the general economy.

Analysis and results:
The analytic approach was satisfactorily reported and the model structure was described fully, with a diagram. The results were reported clearly and in full. Appropriate sensitivity analyses were performed and reported clearly. The base-case estimates of effectiveness, utility, and costs were all reported. The author acknowledged and highlighted the limitations of the study.
Concluding remarks:
The methods and reporting of the study were satisfactory and the results appear to be reliable.

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