Determining the cost effectiveness of a smoke alarm give-away program using data from a randomized controlled trial

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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 a smoke alarm give-away programme, called the 'Let's Get alarmed!' Initiative, which distributed smoke alarms, batteries and fire safety brochures.

Type of intervention
Primary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised households located in administrative units with above average material deprivation, defined as a Jarman Under Privileged Area score of 20 or higher.

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

Dates to which data relate
The effectiveness and resource use data were derived from a study published in 2002. A unique price year was not reported, but the unit costs were taken from sources published in 1998, 1999 and 2000.

Source of effectiveness data
The effectiveness evidence was derived from a single study.

Link between effectiveness and cost data
The costing was carried out prospectively on the same sample of patients as that included in the effectiveness analysis.

Study sample
Power calculations, if performed, were not reported. Forty wards, averaging 3,683 households in each, were included in the current study. There were 20 wards in each group. Wards were selected if characterised by above average material deprivation, defined as a Jarman Under Privileged Area score of 20 or higher. Other details on the method of sample selection were not reported.

Study design
This was a prospective, cluster-randomised controlled trial that was carried out in the inner London Boroughs of Camden and Islington. Wards were pair matched according to the Jarman score. Free smoke alarms, batteries and fire safety brochures were distributed to the intervention wards. Random allocation to either intervention was undertaken within the matched pairs. The mean follow-up was 23.9 months (Range: 22.9 to 25). No data on the loss to follow-up were reported.

Analysis of effectiveness
The primary outcome measures used were the number of fires per ward, the number of fire-related injuries per ward, and the number of fire-related deaths per ward (over 24 months). Injuries were defined as those that resulted in an accident and emergency department (AED) attendance, hospitalisation or death. These data were collected from local AED registers. Deaths occurring as a result of fire were recorded in the AED and follow-up forms, or in coroners’ reports. The baseline comparability of the study groups was not reported, but statistical methods were used to deal with this potential issue.

Effectiveness results
The expected number of fires per ward was 26.3 (Interquartile range, IQR: 24.92 to 27.19) in the control group and 29.04 (IQR: 27.67 to 30.48) in the intervention group.

The probability of a household having a fire in 24 months was 0.00707 (IQR: 0.00676 to 0.00738) in the control group and 0.00789 (IQR: 0.00751 to 0.00828) in the intervention group.

The expected number of fire-related injuries or deaths per ward was 5.172 (IQR: 4.492 to 5.964) in the control group and 6.455 (IQR: 5.627 to 7.418) in the intervention group.

The expected number of fire-related injuries or deaths in a household given that there has been a fire was 0.1987 (IQR: 0.1738 to 0.2272) in the control group and 0.2223 (IQR: 0.1955 to 0.2528) in the intervention group.

The expected number of fire-related injuries per household was 0.0014 (IQR: 0.0012 to 0.0015) in the control group and 0.0018 (IQR: 0.0015 to 0.0020) in the intervention group.

Clinical conclusions
The effectiveness analysis showed that the smoke alarm give-away programme did not reduce the occurrence of fire-related injuries or death in comparison with no intervention. In effect, households in the intervention group had a higher probability of having a fire than control households.

Modelling
An econometric model was used to handle two features of the trial. First, the unit of analysis for the costs and benefits was the individual household, while the unit of randomisation in the trial was the administrative ward. Second, a large number of individuals in the trial were characterised by zero costs and effects, generating heavily right-skewed cost and effect distributions. Thus, a two-step model was developed. In the first stage the probability of a fire occurring was modelled by a logit model, while in the second stage the costs and effects were modelled conditional on a fire occurring. Since the costs and effects were not normally distributed, they were modelled using a generalised linear model with appropriate best fitting functions and distributions.

Measure of benefits used in the economic analysis
The summary benefit measure used was the number of deaths or injuries observed with the programme and usual care. This measure was obtained from the effectiveness analysis and by means of an econometric model.

Direct costs
The authors stated that the analysis was carried out from a societal perspective. The items included were the give-away programme (alarms and reminder postcards), fire service (time spent by fire pumps) and police service (present at the scene of the fire), property damage and health service. The health service item covered ambulance journeys, AED admission, hospital services, follow-up, visits to doctors, surgery and death (funeral, coroners and autopsy). The unit costs were presented separately from the quantities of resources used for all items. Resource use was estimated on the basis of data derived from the clinical trial. The costs came from several sources, such as the Fire Brigade, the London Fire and Civil Defence Authority, the British Crime Survey, local sources, Personal Social Services Research Unit, and published studies. Discounting was not relevant as the costs were incurred during two years. A unique price year was not reported.

**Statistical analysis of costs**
The costs were presented as mean values with IQRs. These were obtained by Monte Carlo simulations.

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

**Currency**
UK pounds sterling (€).

**Sensitivity analysis**
Standard sensitivity analyses were not performed, but Monte Carlo simulations were carried out to estimate intervals around the mean values. Acceptability curves were also presented.

**Estimated benefits used in the economic analysis**
See the ‘Effectiveness Results’ section.

**Cost results**
The expected cost of a fire given that there has been a fire was 1,519.98 (IQR: 1,371.75 to 1,684.24) in the control group and 1,344.99 (IQR: 1,215.89 to 1,487.80) in the intervention group.

The mean cost per household, excluding the cost of the give-away programme, was slightly higher in the control group than in the intervention group (10.74 versus 10.61). However, when the cost of the give-away programme was included (2.15 per household), the mean cost per household was 10.74 (IQR: 9.60 to 12.02) in the control group and 12.76 (IQR: 11.63 to 14.02) in the intervention group.

**Synthesis of costs and benefits**
Two approaches were used to combine the costs and benefits.

First, an incremental cost-effectiveness analysis was used. However, incremental cost-effectiveness ratios were not calculated as the programme was dominated by usual care, which was both more effective and less costly.

Second, cost-effectiveness acceptability curves were constructed for different thresholds of societal willingness to pay (WTP). When the WTP to avoid a death or injury was 0, then the probability that the programme was cost-effective (cost-saving) was 18%. When the WTP was set at 1,000, then the probability decreased to 15%. Finally, when the WTP was set at 50,000, the probability value fell to 11%.

**Authors’ conclusions**
The authors concluded that the smoke alarm give-away programme was unlikely to be cost-effective in the UK. However, they pointed out that this could be due to the fact that few smoke alarms were distributed, installed and maintained during the study period. Thus, other types of programme might be more effective and efficient.

**CRD COMMENTARY - Selection of comparators**

The rationale for the selection of the comparator was clear since the option of no intervention reflected usual care in the authors' setting. You should decide whether this is a valid comparator in your own setting.

**Validity of estimate of measure of effectiveness**

The effectiveness data came from a clinical trial, which was appropriate for the study question. Limited information on the design and other aspects of the trial were reported in the current article. Thus, it was difficult to assess the validity of the primary estimates. However, the randomised design and the large number of individuals involved enhance the robustness of the study. Appropriate statistical methods were used to deal with issues arising from the trial, such as the different unit of randomisation and of analysis and the right-skewed effectiveness results.

**Validity of estimate of measure of benefit**

The summary benefit measure was specific to the interventions considered in the study. It would not be comparable with the benefits of other health care interventions.

**Validity of estimate of costs**

The analysis of the costs was carried out in accordance with the perspective adopted in the study, although the indirect costs were not considered. Extensive details of the unit costs and quantities of resources used were provided. This enhances the possibility of replicating the analysis in other settings. The source of the costs was reported for each item. However, the cost estimates were specific to the study setting and the impact of using different costs was not investigated. The price year was not reported, which will prevent reflation exercises in different time periods. Appropriate statistical methods were used to deal with the issue of the right-skewed cost results. These methods were accurately described.

**Other issues**

The authors noted that the current study showed that an experimental design is feasible to assess the effectiveness of a smoke alarm give-away programme. They stated that the current results differed from those of a published observational study, which showed fewer deaths or injuries associated with the intervention. The issue of the generalisability of the study results to other settings was not explicitly addressed. However, the use of the acceptability curve framework addressed the issue of uncertainty in the cost-effectiveness results. The authors pointed out the strengths of their methodological analysis.

**Implications of the study**

The study results do not support the implementation of a smoke-alarm give-away programme. The authors noted that further studies should investigate efficient and effective ways of getting appropriate smoke alarms into high-risk homes.

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