Short-term economic and health benefits of smoking cessation: myocardial infarction and stroke

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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
Smoking cessation in adult smokers.

Type of intervention
Primary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
Adult smokers aged 35 to 64 years.

Setting
Primary care and hospital. The economic study was carried out in California, USA.

Dates to which data relate
The effectiveness data were extracted from studies published in the period 1981 to 1996. The resource use and cost data were derived from the published literature from 1981 to 1997. The fiscal year was 1995.

Source of effectiveness data
Effectiveness data were derived from a review of previously published studies and assumptions conducted by the authors.

Modelling
The authors performed a series of Monte Carlo simulations for acute myocardial infarction and stroke.

Outcomes assessed in the review
The following outcomes were related to AMI (for males and females separately) and stroke (for both males and females): the proportion of smokers, the proportion of ex-smokers, the observed incidence in the population, annual survival probability, and annual survival probability after event for the first, second and following years.

Study designs and other criteria for inclusion in the review
In order to estimate relative risk over time (RR(t)), four criteria were used for the selection of studies:
(1) studies had to contain outcomes related to RR and AMI, and to report clinical incidents according to ICD-9 diagnosis codes for hospitalisation statistics;

(2) studies had to report age-adjusted RR;

(3) studies had to have either a case-control design reporting RRs adjusted for a number of co-factors and effect modifiers or to be a population-based study potentially applicable to the US;

(4) studies had to adjust for pre-existing confounders to reduce the possible effect of "quitting sick effect" on the RR estimates.

Two studies used for the estimation of the fall in the risk of stroke after smoking cessation were prospective cohort studies. Three studies used for AMI were reported to be retrospective case-control studies.

**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**
A total of 16 studies were directly used as the references for the outcomes assessed in the review.

**Methods of combining primary studies**
A meta-analysis could not be applied since the studies did not have similar time horizons, instead the data were combined and a function for the fall in RR as a function of time was estimated using a functional form of exponential decay in the ln RR. Regression estimates were used to calculate the average RRs for all current smokers and ex-smokers.

**Investigation of differences between primary studies**
Not reported.

**Results of the review**
The following outcome results for males and females were related to AMI:

- proportion of smokers, 0.301 (male) and 0.250 (female);
- proportion of ex-smokers, 0.288 (m) and 0.205 (f);
- observed incidence in the population, 0.00502 (m) and 0.00159 (f);
- annual survival probability, 0.99163 (m) and 0.99497 (f);
- annual survival probability after event for first year, 0.812 (m) and 0.765 (f);
- annual survival probability after event for second and following years, 0.944 (m) and 0.933 (f).
The following outcome results were related to stroke (for both male and female):

- proportion of smokers, 0.275;
- proportion of ex-smokers, 0.245;
- observed incidence in the population, 0.00219;
- annual survival probability, 0.99334;
- annual survival probability after event for first year, 0.663;
- annual survival probability after event for second and following years, 0.961.

**Methods used to derive estimates of effectiveness**

Assumptions about effectiveness were also made by the authors.

**Estimates of effectiveness and key assumptions**

Smokers and ex-smokers without the experience of an event were "assumed to have the annual survival probability of the average current smoker aged 35 to 64". A person with an experience of hospitalisation at year t was "assumed to have the average annual survival probability for the first year after hospitalisation". It was assumed that "the RR of events for smokers versus non-smokers was the same for first and subsequent events".

**Measure of benefits used in the economic analysis**

The measure of benefits was cases of AMI and stroke avoided annually for two patterns of cessation: one-time 1% reduction in smoking prevalence, and annual (up to 7 years) 1% reduction in smoking prevalence.

**Direct costs**

Costs were discounted. Resource utilisation was not fully reported separately from the costs. The cost items were not reported separately. The cost analysis covered the direct medical cost of initial treatment of AMI, the expected costs of major surgical procedures related to AMI, the annual cost of follow-up and rehabilitation related to AMI, short-term costs of treatment of stroke, rehabilitation costs of stroke, and costs of care in nursing facilities. The direct medical cost covered the operating costs. The resource use and cost data were extracted from the literature. Medicare cost-to-charge ratio was used to translate the charges to true costs. The perspective adopted in the cost analysis was not explicitly specified. The price date was 1995. The cost of thrombolytic therapy was not included in the analysis.

**Indirect Costs**

Not considered.

**Currency**

US dollars ($).

**Sensitivity analysis**

A one-way simple sensitivity analysis was performed on discount rate. Multiple Monte Carlo simulations for acute myocardial infarction and stroke were carried out.

**Estimated benefits used in the economic analysis**

The number of cases (standard deviation) of AMI and stroke avoided annually for two patterns of cessation
corresponding to one-time 1% reduction in smoking prevalence in the first year were 924 (679) and 538 (508), respectively. The number of cases of AMI and stroke avoided for a 7-year programme with an annual 1% reduction in smoking prevalence amounted to 63,840 (25,521) and 34,366 (9,261), respectively.

**Cost results**
The discount rate was 2.5%. The average cost of AMI for the first year was $30,924 for males, $30,819 for females, and $29,043 for stroke. In the first year, the undiscounted savings associated with 1% smoking cessation was $44 million. Over 7 years, the cumulative undiscounted savings were $993 million.

**Synthesis of costs and benefits**
Costs and benefits were not combined since the smoking cessation programme in the age group between 35 to 64 was the dominant strategy in terms of short-term outcomes. The results of Monte Carlo simulations were reported to be "within 2% across multiple simulations”

**Authors' conclusions**
Although primary prevention of smoking among teenagers is important, reducing adult smoking pays more immediate dividends, both in terms of health improvements and cost savings.

**CRD COMMENTARY - Selection of comparators**
The reason for the choice of the comparator is clear.

**Validity of estimate of measure of benefit**
As the authors acknowledged, a limitation of the internal validity of the estimates of benefit is the non-randomised or retrospective design of the studies identified in the literature review.

**Validity of estimate of costs**
The resource utilisation was not fully reported separately from the costs and insufficient detail of the methods of cost estimation was given. True costs, in some cases, were not measured directly, but were estimated based on charge data using a cost-to-charge ratio.

**Other issues**
Given the lack of randomisation, sensitivity analysis, and statistical analysis of the costs, the results need to be treated with some caution. The issue of generalisability to other settings or countries was not addressed.

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