Cost-effectiveness of lung cancer screening in Japan

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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
Different types of screening for lung cancer were studied:

- Mass screening performed with indirect chest X-ray for all persons and sputum cytology for high-risk individuals (individuals with high smoking index); and
- Mass screening performed with computed tomography (CT).

Mass screenings performed in 1983 and 1993 with indirect chest X-ray and sputum cytology were compared. All the screenings were performed at yearly intervals.

Type of intervention
Screening.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised all individuals aged 40 to 84 years in Japan. No exclusion criteria were applied.

Setting
The clinical setting was not reported and it was unclear from the context of the paper. The economic study was performed at the Kanagawa Cancer Center, Yokohama, Japan.

Dates to which data relate
The price year was not reported. The effectiveness data were derived from the lung cancer incidence rates in Japan in 1983 and 1993. Resource use data were derived from the author's assumptions, for which no dates were given.

Source of effectiveness data
The effectiveness data were based on the author's assumptions.

Modelling
A published, deterministic mathematical model (Iinuma et al., see Other Publications of Related Interest) was used to estimate the life-years saved and expected costs of the three hypotheses of mass screening and the no-screening alternative. An algorithm was used to estimate the number of persons saved by screening per year on the basis of cancer incidence, sensitivity of primary screening, detailed examination rate and sensitivity, and 5-year survival rate. A further algorithm was used to obtain the costs of the different screening alternatives (versus no screening) on the basis of the number of persons screened, mean life expectancy (by age and gender), cost of primary screenings, cost of lung cancer...
therapy for outpatients, cost of a detailed examination and the percentage of patients requiring detailed examinations.

**Methods used to derive estimates of effectiveness**
The effectiveness data were based on the author's assumptions. It is likely that some of the effectiveness data were also taken from Japanese databases and published studies, but the author did not explicitly report the data sources.

**Estimates of effectiveness and key assumptions**
The following assumptions were made:

- in 1983, the incidence rate of lung cancer in men ranged from 6.2 per 100,000 (40- to 44-year-old age group) to 467.9 per 100,000 (80- to 84-year-old age group);
- in 1983, the incidence rate of lung cancer in women ranged from 4.1 per 100,000 (age 40 - 44) to 129.3 per 100,000 (age 80 - 84);
- in 1993, the incidence rate of lung cancer in men ranged from 9.8 per 100,000 (age 40 - 44) to 522.1 per 100,000 (age 80 - 84);
- in 1993, the incidence rate of lung cancer in women ranged from 5.3 per 100,000 (age 40 - 44) to 120.1 per 100,000 (age 80 - 84);
- in 1983, the life expectancy ranged from 34.8 years (age 40 - 44) to 5.7 years (age 80 - 84) for men, and from 39.8 years (age 40 - 44) to 7.0 years (age 80 - 84) for women;
- in 1993, the life expectancy ranged from 35.9 years (age 40 - 44) to 6.0 years (age 80 - 84) for men, and from 41.6 years (age 40 - 44) to 8.0 years (age 80 - 84) for women;
- the sensitivity of standard mass screening was 70% in 1983 and 1993, while the sensitivity of screening with CT was 90%;
- the proportion of patients requiring a detailed examination was 2% with standard mass screening and 5% with CT screening;
- the 5-year survival rate of screen-detected patients was 30% with standard mass screening and 60% with CT screening;
- the 5-year survival rate of no screened patients was 10%.

**Measure of benefits used in the economic analysis**
The main measures of benefit used in the economic analysis were the lives saved and life-years saved. The authors estimated these values using the mathematical model.

**Direct costs**
No discounting was applied, although it would have been relevant given the time horizon of the analysis. The unit costs were reported separately from the resources used, which were based on the author's assumptions. The quantity/cost boundary was not reported and it was unclear from the paper. The categories of costs included in the analysis were standard mass screenings and screening with CT, detailed examination, therapy for screened patients and therapy for non-screened patients (patients in whom lung cancer was diagnosed by outpatient visits). The cost of screening CT was derived from a published study, while the source of the other unit costs was not reported. Resource use was based on the assumption of one screening per year and assumptions about the rate of participation in detailed examinations and the percentage of patients requiring examinations. The quantity of resource use appears to have been measured in 1983.
and 1993. The price year was not reported.

**Statistical analysis of costs**
No statistical analysis of the costs was carried out.

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

**Currency**
Japanese Yen (Y). The unit costs were also reported in US dollars ($).

**Sensitivity analysis**
Sensitivity analyses were not performed.

**Estimated benefits used in the economic analysis**
The benefit results for the three screening alternatives were not reported. The authors only reported cost-effectiveness ratios.

**Cost results**
The total intervention costs were reported graphically as the ratio between the cost per screened and non-screened individuals (for each age class and gender). A ratio lower than one meant that the total cost per screened individual was lower than the total cost per non-screened individual, even with the added expenses of screening. This ratio decreased for all three screenings alternatives (mass screening in 1983, mass screening in 1993 and mass screening with CT in 1993) with increases in age. However, it fell below one for men aged 55 years or older and for women aged 65 years or older. There were almost no differences between mass screenings in 1983 and 1993, while the ratio was always higher for screening with CT.

**Synthesis of costs and benefits**
The cost-effectiveness results were also only reported graphically. The cost per life-year saved for screening with CT was slightly lower than that with mass screening in 1983 and in 1993, both for men and for women, and for all age classes. There were no major differences between screening in 1983 and in 1993, apart from women aged 50 years or less for whom the cost per life-year saved was lower for screening in 1993. In general, the cost per life-year saved decreased with age in both men and women for all of the screening strategies. However, for individuals aged 60 or older, the cost per life-year saved for women was approximately double that for men, probably due to the lower incidence of lung cancer in women. The authors stated that the same trends were observed in the cost per life saved, but they did not report the cost-effectiveness results for this alternative benefit measure.

**Authors’ conclusions**
Screening using computed tomography (CT) should become the most appropriate screening method for lung cancer. Although more expensive than the other two alternatives, CT screening turned out to be the most cost-effective strategy, given its higher sensitivity.

**CRD COMMENTARY - Selection of comparators**
The rationale for the choice of the comparator was clear. The standard mass screening methods were compared to the potential future screening method (screening with CT). You should decide whether no guided choice represents a valid comparator in your own setting.
Validity of estimate of measure of effectiveness
The effectiveness data used in the mathematical model were based on the author's assumptions. There were no details about the source from which the effectiveness data were estimated, thus it is not possible to judge the validity of these data. However, the lack of information is, in itself, a limitation on the effectiveness analysis.

Validity of estimate of measure of benefit
The benefit results were derived using a deterministic mathematical model that had been published in the literature. The model was described in detail and information on each parameter included in the model was given. The life-years saved is an appropriate measure to estimate the cost-effectiveness of screening programmes. However, the authors did not report the specific benefits results for the alternative strategies included in the study.

Validity of estimate of costs
The perspective of the analysis was unclear. Hence, it is not possible to judge whether all the relevant cost categories were included. Also, the source of the majority of the unit costs was not given. The cost results were only reported as the ratio between the costs per screened and non-screened individuals, and not as the total costs for each screening strategy. Also, no sensitivity analyses were performed. The transferability of the results appears very low.

Other issues
The cost-effectiveness results were presented graphically, which makes it difficult to interpret the exact results for each screening alternative and whether or not the difference in the results was substantial. The author did not perform any sensitivity analysis and did not compare the results of the analysis with other published studies. Thus, the issue of generalisability was not addressed. The rationale for comparing mass screening in 1983 and mass screening in 1993 was unclear. The only difference between the two appears to have been the lung cancer incidence and life expectancy (not a difference in the screening methods). The detailed sub-group analysis for age class and sex gave strength to the study. However, a general limitation was the lack of information on the sources of the costs and effectiveness data, and the lack of tables reporting the final results.

Implications of the study
The results of the study indicated a future beneficial trend for lung cancer screening with CT in the Japanese health care system.

Source of funding
None stated.

Bibliographic details

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Other publications of related interest
MeSH
Adult; Age Factors; Aged; Cost-Benefit Analysis; Female; Humans; Incidence; Japan /epidemiology; Lung Neoplasms /diagnosis /economics /prevention & control; Male; Mass Chest X-Ray /economics; Mass Screening /economics /methods; Middle Aged; Models, Theoretical; Sex Factors; Sputum /cytology; Tomography, X-Ray Computed

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