Multicentre aneurysm screening study (MASS): cost effectiveness analysis of screening for abdominal aortic aneurysms based on four year results from randomised controlled trial

Multicentre Aneurysm Screening Study Group

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
Screening for abdominal aortic aneurysm (AAA), based on ultrasonography of the abdominal aorta with a portable ultrasound machine, was examined. Individuals found to have a normal aorta (less than 3 cm diameter) received no further follow-up. Those with an aortic diameter of 3.0 to 4.4 cm were allocated to annual scans in hospital, while those with an aortic diameter of 4.5 to 5.4 cm were allocated to scans every 3 months. Men with an aneurysm with aortic diameter of 5.5 cm or greater, rapid expansion (at least 1 cm within one year), or symptoms attributable to the aneurysm, were referred to a vascular consultant for assessment of suitability for surgery.

Type of intervention
Screening.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised men aged 65 to 74 years. No further inclusion and exclusion criteria were reported.

Setting
The setting was primary care. The economic study was conducted in the UK.

Dates to which data relate
Collection of the effectiveness and resource use data started in 1997 to 1999 and lasted 4 years. The costs were estimated in the financial year 2000/01.

Source of effectiveness data
The effectiveness evidence was derived from a single study, the main details of which had been published elsewhere (see Other Publications of Related Interest'), and some authors' assumptions.

Link between effectiveness and cost data
The costing was conducted prospectively on the same sample of patients as that used in the effectiveness study. However, some cost information also came from other groups of patients.

Study sample
Power calculations were conducted in the preliminary phase of the study. These suggested that the trial was designed to have an 80% power to detect a 30% reduction in deaths related to AAA at the 5% level of significance. The methods
used to select the sample were unclear. An overall sample of 67,800 individuals was contacted. The individuals were then allocated to receive either ultrasound screening for AAA (n=33,839) or no such screening (n=33,961). No other details of the patients' characteristics were provided.

Study design
This was a prospective, multi-centre, randomised clinical trial that was conducted at four centres in the UK. The method of randomisation was not described. Few details of the follow-up were reported. The length of follow-up was 4 years. It was unclear whether some patients were lost to the follow-up assessment.

Analysis of effectiveness
The analysis of the clinical study appears to have been conducted on an intention to treat basis. Patients with less than 4 years of follow-up, and those who died from other causes than those related to AAA, were treated as censored observations. The outcome measures used in the analysis were the number of AAA-related deaths and survival time. The baseline comparability of the study groups was not discussed.

Effectiveness results
The number of AAA-related deaths was 58 in the intervention group and 105 in the control group.

The survival time was 1,459.41 (+/- 0.228) days in the intervention group and 1,458.54 (+/- 0.271) days in the control group.

Clinical conclusions
The effectiveness study showed that the screening strategy for AAA led to a substantial reduction in the number of AAA-related deaths. However, over the 4-year period, the survival time between screening and no screening was quite comparable.

Methods used to derive estimates of effectiveness
The authors made some assumptions to extrapolate the 4-year clinical results to a 10-year timeframe.

Estimates of effectiveness and key assumptions
It was assumed that:

the benefits of screening were restricted to mortality related to AAA;

those for whom such deaths were presented were subjected to the same "other cause" mortality as the general population; and

in years 5 to 10, the absolute risk reduction in such mortality accumulated at only half the rate of that observed in years 2 to 4.

Measure of benefits used in the economic analysis
The summary benefit measure used was survival time. This was derived directly from the effectiveness analysis. An annual rate of 1.5% was used in the base-case analysis.

Direct costs
Discounting was applied as the costs were incurred during a timeframe of longer than 2 years. An annual rate of 6% was applied. The unit costs were presented separately from the quantities of resources used for most items. The health
services included in the economic evaluation were those related to screening (invitation, re-invitation, initial screening, and recall scan) and those related to surgery (consultation before elective surgery, elective surgery, and emergency surgery). The cost/resource boundary of the health services was applied. Resource use was mainly estimated using data coming from the same sample of patients as that considered in the effectiveness study. Other data on elective and emergency procedures were derived from cohorts of male patients aged 65 years and older. All screening equipment was assumed to have a useful life of 5 years. The authors also made an assumption about the costs incurred in the 5 to 10 years after the first screening. The costs were estimated from centre-specific unit costs, wholesale drug prices, and NHS trusts. The costs were presented on the price base of the financial year 2000/01.

Statistical analysis of costs
A linear regression model was used to predict the hospital drug costs for all patients from a sub-sample of patients. The authors used nonparametric bootstrap methods, adjusted for bias, to estimate the confidence intervals (CIs) around the mean resource use and costs. Patients with less than 4 years of follow-up, and those who died from causes other than those related to AAAs, were treated as censored observations and periods of 6 months were used for censored costs.

Indirect Costs
The indirect costs were not considered.

Currency
UK pounds sterling (£).

Sensitivity analysis
One-way sensitivity analyses were conducted to assess the robustness of the estimated cost-effectiveness ratios. Variations in the discount rate, costs of elective and emergency surgery, screening costs, and survival gain were investigated. The sources of alternative data were the clinical trial, authors’ hypothesis, and study centres. A cost-effectiveness acceptability curve was also used to assess the probability that the cost-effectiveness ratio fell below a given threshold.

Estimated benefits used in the economic analysis
The survival time was 1,459.41 (+/- 0.228) days in the intervention group and 1,458.54 (+/- 0.271) days in the control group.

After discounting (at 1.5%), survival time was 1,394.73 (+/- 0.216) days in the intervention group and 1,393.92 (+/- 0.256) days in the control group.

The difference in survival time after discounting was 0.82 days (95% CI: 0.16 - 1.47).

Cost results
Over the 4-year period, the total costs were 3,379,576 in the intervention group and 1,220,146 in the control group. The costs per patient were 99.87 (intervention group) and 35.93 (control group), respectively.

After the adjustment for censoring, the per patient costs were 103.67 (standard error, SE=4.41) in the intervention group and 38.22 (SE=3.32) in the control group.

After adjusting for censoring and discounting at 6% per year, the per patient costs were 98.42 (SE=4.15) in the intervention group and 35.03 (SE=3.04) in the control group.

The difference in costs after discounting was 63.39 (95% CI: 53.31 - 73.48).
Synthesis of costs and benefits

An incremental cost-effectiveness ratio was calculated, so as to combine the costs and benefits.

The incremental cost per life-year gained with screening over no screening was 28,389 (95% CI: 15,281 - 145,598) in the base-case.

The sensitivity analysis showed that the estimated cost-effectiveness ratio was sensitive to the magnitude of the clinical effect and variations in the screening costs.

The cost-effectiveness acceptability curve suggested that, at 30,000 per life-year gained with screening, the probability that screening was cost-effective under base-case conditions was 55%.

At 10 years, the cost per life-year gained with screening would be 8,000.

Authors' conclusions

After 4 years, a screening programme for abdominal aortic aneurysm (AAA) among individuals aged 65 to 74 years was at the margin of acceptability, according to current NHS thresholds, and its cost-effectiveness improved dramatically over time.

CRD COMMENTARY - Selection of comparators

The rationale for the choice of the comparator was clear. No screening was selected because it represented the comparator in the primary trial. It reflected the standard care in the UK, as well as in other settings. You should decide whether this is a valid comparator in your own setting.

Validity of estimate of measure of effectiveness

The internal validity was likely to have been high due to the robust design of the clinical trial. The authors justified the choice of the sample size and the clinical study appears to have been conducted on an intention to treat basis. However, there was limited information on the trial, as most of the details had been published elsewhere. The baseline comparability of the study groups was not discussed and the method used to select the sample was not reported. The comparison conducted in the study approximated the form that a national screening programme could take in UK.

Validity of estimate of measure of benefit

The summary benefit measure was appropriate as it reflected the impact of the intervention on patient survival, which is a relevant aspect of health for patients suffering from AAA. The authors acknowledged that the inclusion of quality of life could have been interesting. A rough assessment of the quality-adjusted life-years was made, resulting in a cost per QALY of 36,000.

Validity of estimate of costs

The perspective adopted in the study was reported clearly. All the relevant categories of costs were included in the analysis. A detailed breakdown of the cost items was provided, and the information on the unit costs and quantities of resources used was clear. This enhances the possibility of replicating the study in other settings. The price year was given, which makes reflation exercises easy. Statistical tests were conducted because of the non-normal distribution of the costs. Sensitivity analyses were also conducted on the most relevant categories of costs. The source of the data was reported, as were the assumptions made to project the estimated costs over the long term. Detailed information on the methods of cost calculation was provided. The use of alternative discount rates was investigated in the sensitivity analysis.

Other issues

The authors did not compare their findings with those from other studies. They also did not address the issue of the
generalisability of the study results to other settings. Few sensitivity analyses were conducted, which affected the external validity of the analysis. However, the uncertainty around the main outcomes was correctly handled using acceptability curves. The authors noted that the results of the study could have been biased, but all assumptions were conservative, thus favouring the comparator. The study referred to individuals aged 65 to 74 years and this was reflected in the conclusions of the analysis.

**Implications of the study**
The study results supported the cost-effectiveness of screening for AAA in older men. The authors noted that more elaborate modelling is required to better assess the long-term cost-effectiveness of screening for AAA.

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**Other publications of related interest**


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