Cost effectiveness and cost utility of an organized screening programme for glaucoma

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 assessed an organised screening programme for glaucoma at 5-year intervals in comparison with opportunistic case-finding (current practice). The examinations carried out in the screening arm were measurement of intraocular pressure, fundus evaluation, autorefraction and visual field examination. For positive cases, another test was carried out in order to confirm the findings. If patients were diagnosed with glaucoma they would be provided with treatment and would be followed up. In the follow-up, tonometry was performed twice a year and imaging and automated perimetry once in 2 years. Current practice consisted of all images and visual fields in the private sector that were taken because of glaucoma.

Type of intervention
Screening.

Economic study type
Cost-effectiveness analysis, cost-utility analysis

Study population
The study used a hypothetical population aged 50 to 79 years that included patients with a diagnosis of glaucoma. Follow-up was until the age of 89 or death. The authors simulated eight cohorts of different age groups (5-year age groups between 50 and 79 years) from this population. The authors also defined a target population of 1 million people, with the same characteristics as the study population, for the time horizon of the model.

Setting
The setting was not explicitly stated. However, screening is likely to have taken place in an outpatient setting. The economic study was carried out in Finland.

Dates to which data relate
The sensitivity and specificity of the diagnostic tests were collected from a study published in 2003. Epidemiological and treatment data used to compute probabilities were collected from studies published between 1981 and 2004. The cost data were collected from studies published between 1990 and 2003. The price year was 2003.

Modelling
A Markov model with a time horizon that varied from 40 years in the youngest age group to 10 years in the oldest age group (20 years on average) was developed. The 14 health states, possible transitions within the model, cycle length, age-specific probabilities and general probabilities were presented in full in the paper, along with a number of modelling assumptions which were fully justified.

Study designs and other criteria for inclusion in the review
The clinical parameters associated with the programme included the transition probabilities for the different Markov states, such as progressive changes for treated and untreated eyes per 5 years, and also the probability of glaucoma patients undergoing laser or surgical procedures. Other data included screening sensitivity, specificity, participation and failure, as these also affect the probabilities of moving from one state to another. Epidemiological data included the prevalence of: glaucoma, suspected glaucoma, severe visual disability, diagnosed glaucoma, incidence of glaucoma, mortality of glaucoma patients and drug-treatment hypertension.
Sources searched to identify primary studies
The estimated sensitivity and specificity of the diagnostic tests were taken from a systematic review, the Finnish EBM Guideline for Glaucoma (Tuulonen et al. 2003, see ‘Other Publications of Related Interest’ below for bibliographic details). The epidemiological data were derived from different studies, some of which were data registers, while others provided mathematical formulae for the computation of probabilities. Given the lack of available data, the authors assumed a linear manner of progression and estimated the progression rates from two randomised controlled trials.

Methods used to derive estimates of effectiveness
The methods used to obtain clinical data were not well reported in the paper. Communication with the authors after this abstract was published has indicated that a systematic review of the literature was performed, but that most of the data were taken from a published systematic review updated in 2007.

Measure of benefits used in the economic analysis
Two measures of benefit were used in the economic analysis. For the cost-effectiveness analysis, the measure of benefit was the years of visual disability avoided by screening. For the cost-utility analysis, the measure of benefit was the quality-adjusted life-years (QALYs) gained. Health-related quality-of-life scores were measured by the generic 15D instrument (Sintonen 2001, see ‘Other Publications of Related Interest’ below for bibliographic details) in the 5-year age groups in different Markov states. These were estimated by means of regression analyses. The data came from the Finnish Health 200 Health Examination Survey, which was representative of the Finnish population aged 30 years and over (n=6,269). The benefits were discounted at a rate of 5% according to the Ministry of Social Affairs and Health 2004, and at a rate of 3.5% as recommended by the National Institute for Health and Clinical Excellence (NICE).

Direct costs
The direct costs included in the analysis were those of the health service. The costs included were the direct health care and non-health care costs. The average costs presented were taken from various secondary sources and covered follow-up, glaucoma medication, glaucoma operation, screening and visual disability. The units of resources used and unit costs were presented separately for 269,300 annual primary screenings and 27,000 annual secondary screenings in 14 screening centres throughout the country. These included personnel, equipment, premises, travelling and social services (in the case of visual disability). The authors calculated the costs of fundus evaluation in two ways: first, for one wide-angle black-and-white red-free image per eye, and second, using Heidelberg Retina Tomography. The screening costs for perimetry were calculated using both the Humphrey SITA-Fast program, and Frequency Doubling Technology. The sources of these unit costs and resources were unclear. The price year was 2003. The costs were discounted at an annual rate of 5% according to the Ministry of Social Affairs and Health 2004, and at a rate of 3.5% as recommended by NICE.

Statistical analysis of costs
No statistical analyses of the costs were conducted as the objective of the study was to produce cost-utility and cost-effectiveness measures.

Indirect Costs
No productivity losses were considered. The authors justified this by stating that the screening programme targeted mainly older groups.

Currency
Euros (EUR).

Sensitivity analysis
Parameter uncertainty was investigated through probabilistic sensitivity analyses: one-way sensitivity analysis of all variables, and threshold analysis by age cohorts for variables to which the results were most sensitive. The ranges over which the variables were tested in the deterministic analyses were presented in full for those variables also subjected to threshold analyses. All parameter distributions used in the probabilistic sensitivity analysis were defined. This analysis used 10,000 Monte Carlo simulations. Variability was also investigated given that the authors also assessed the cost-utility of screening in different age groups.

Estimated benefits used in the economic analysis
For the base-case of the cost-effectiveness analysis and at a discount rate of 5%, the number of years of visual disability avoided with screening was 0.00093.

For the base-case of the cost-utility analysis and at a discount rate of 5%, the number of QALYs gained with the screening programme was 0.00336.

For the target population of 1 million, during the time horizon of the model and at a discount rate of 5%, 930 years of visual disability would be avoided and 3,360 incremental QALYs would be produced, by 701 persons. The undiscounted values would be 3,480 years and 6,320 QALYs.

**Cost results**
The cost of opportunistic case-finding, discounted at a 5% rate, was EUR 853.00. The cost of screening, discounted at a 5% rate, was EUR 883.32.

For the base-case of the cost-effectiveness and cost-utility analyses, and at a discount rate of 5%, the incremental cost of screening compared with opportunistic case-finding was EUR 30.32.

For the target population of 1 million, during the time horizon of the model and at a discount rate of 5%, the cumulative incremental costs of screening would be EUR 30 million. The undiscounted value would be EUR 24.5 million.

**Synthesis of costs and benefits**
The costs and benefits were combined to give incremental cost-effectiveness and cost-utility ratios (ICER and ICUR, respectively), cost-effectiveness planes and cost-effectiveness acceptability curves in different age groups.

For the cost-effectiveness analysis and at a discount rate of 5%, the incremental cost of 1 year of avoided disability by screening in comparison with opportunist case-finding was EUR 32,602 (ICER).

For the cost-utility analysis, the cost of one QALY gained by screening in comparison with opportunistic case-finding was EUR 9,024 (ICUR) with a discount rate of 5% and EUR 7,582 (ICUR) with a discount rate of 3.5%.

It was reported that the cost varied from EUR 52,517 per QALY gained in the youngest cohort to strong dominance in the three oldest cohorts.

The one-way sensitivity analysis revealed that the results were sensitive to estimates of the specificity of the screening tests, screening cost, discount rate, follow-up cost, participation rates, prevalence of suspected glaucoma and prevalence of glaucoma. The results were quite robust for variation in all other variables.

The threshold analysis showed that the results for older age groups were more tolerant to changes in the specificity of the test than younger age groups.

**Authors’ conclusions**
The authors concluded that an organised glaucoma screening programme can be a cost-effective strategy in comparison with opportunistic case-finding in Finland, especially in older age groups, in which screening is clearly more likely to be acceptable to decision-makers at any level in terms of their willingness-to-pay for a quality-adjusted life-year (QALY).

**CRD COMMENTARY - Selection of comparators**
Although not clearly stated, it appears that the comparator used, opportunistic case-finding, represented current practice in the study setting. You should decide if the comparator represents current practice in your own setting.

**Validity of estimate of measure of effectiveness**
The parameters were mainly derived from published studies augmented by authors’ assumptions with regard to the calculation of progressive changes for treated and untreated eyes. Although the authors provided some justifications for their selection of the estimates, they did not report any search methods or inclusion criteria. Since this abstract was
published we have been informed by the authors that a systematic review of the literature had been performed. The authors acknowledged that the estimates of sensitivity and specificity used were optimistic.

Validity of estimate of measure of benefit
The estimation of health benefits (years of visual disability avoided and QALYs gained) were modelled using a Markov model. Both measures seem to have been appropriate, with QALYs enabling comparisons with other technologies and fully capturing health outcomes. The methods used to estimate the utility weights were described in full. The health benefits were appropriately discounted.

Validity of estimate of costs
Given the perspective of the health system that was adopted in the analysis, the cost categories included seem to have been in accordance with this perspective. All the relevant costs within each category appear to have been included in the analysis. However, detailed costing was not reported. Average costs were presented for some categories and these were taken from published sources. For primary and secondary screening, the resource requirements and unit costs were presented separately. However, the sources of these estimates were not clear. The costs were appropriately discounted and the price year was stated. The authors evaluated uncertainty in the cost data jointly with the health benefits by means of deterministic and probabilistic sensitivity analyses. The cost data appear to have been adequately reported.

Other issues
The authors compared their results with those from two other studies. They showed the results to be in the opposite direction to one of the studies and in agreement with the other. They acknowledged the difficulty of comparing their findings with the findings of other studies and provided further explanation around this issue. The authors evaluated the impact of variations in epidemiology estimates, effectiveness estimates and also costs, on the results of the economic analysis through sensitivity analysis. Nevertheless, they stated that the generalisability of the results should be evaluated in other settings while considering local features, such as systems of opportunistic case-finding. The authors do not appear to have presented their results selectively, although they did not always report all the results of the analysis they performed (e.g. the ICUR for the different age groups were not presented and just the range was mentioned in the text). The study population was reflected in the authors’ conclusions.

The authors reported a number of limitations to their study. In addition to the comments that have been made already, it was stated that the sensitivity and specificity values used might not correspond with reality because of differences in the type of tests used in everyday practice. Another limitation pointed out was the fact that the authors had to assume that the technology, effect of therapy, relative prices, demographics and life expectancy would remain unchanged over the 10- to 40-year time horizon of the model. Furthermore, it was stated that health-related quality of life was based on self-reported diagnosis and use of medication and other treatments. It was emphasised that there was a large degree of uncertainty with respect to some parameters, especially concerning the specificity of diagnostic tests and screening cost. Some shortcomings of the study included the fact that an ICER was not reported for the target population of 1 million, and it was not clear to how many hypothetical patients the results referred to in the base-case.

Implications of the study
It was stated that "policy makers can use the results and model to choose which (if any) age groups are appropriate for screening given their willingness to pay for a QALY or avoided visual disability". The authors recommended that greater attention should be paid to getting realistic estimates for the model parameters. They also made some comments in relation to future research. In particular, the need for a European randomised screening trial, an evaluation of diagnostic test characteristics in large non-selected populations; the establishment of a 'gold'-standard definition of glaucoma, and the measurement of health-related quality-of-life scores measured among individuals assigned by ophthalmologists to the Markov states.

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Bibliographic details