Cost utility of screening for Barrett’s esophagus with esophageal capsule endoscopy versus conventional upper endoscopy

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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 two strategies for screening for Barrett’s oesophagus (BE). One was conventional optical oesophagogastroduodenoscopy (EGD) and the other was oesophageal capsule endoscopy (ECE). Both screening strategies were followed by surveillance. ECE uses a wireless pill-sized capsule containing a camera, battery and transmitter. Images are transmitted to a digital recording device worn by the patient, and are subsequently downloaded to a computer for analysis. A strategy of no screening or surveillance (natural history of disease) was also considered for comparative purposes.

Type of intervention
Screening.

Economic study type
Cost-utility analysis.

Study population
The study population comprised a hypothetical cohort of 50-year-old white men with symptoms of GERD.

Setting
The setting was secondary care. The economic study was carried out in the USA.

Dates to which data relate
The effectiveness data were derived from studies published between 1976 and 2006. No dates for the resource use data were reported. The price year was not explicitly reported, but it could have been 2005.

Source of effectiveness data
The clinical data used to populate the decision model were:

the prevalence of BE, dysplasia and cancer;

the probabilities of transitions among health states (progression to more severe and regression to less severe health states);

the rates of cure and death associated with cancer treatment;

the accuracy of screening tests; and

the complications associated with conventional EGD.
Modelling
A Markov model was constructed on the basis of a published model of screening and surveillance for EAC. The model followed a hypothetical cohort of 50-year-old white men with GERD symptoms until age 80 or death. A simplified graphical representation of the model was reported. Other details of the model, such as cycle length, health states and transition patterns, were also given.

Sources searched to identify primary studies
Information on the design and other characteristics of the primary studies was not reported since such details were taken from a published decision model. Therefore, it was not possible to assess the validity of the primary studies. Some data on screening accuracy were taken from observational studies.

Methods used to judge relevance and validity, and for extracting data
Transition probabilities amongst health states were derived from studies identified in a published systematic review of the literature. Some assumptions were also made, mainly in relation to the diagnostic accuracy of the screening strategies (given the lack of a 'gold' standard).

Measure of benefits used in the economic analysis
The summary benefit measure was the number of quality-adjusted life-years (QALYs). This was estimated using the decision model. The utility weights were reported, but details of the sources of these data were not provided. Some utility estimates were also based on authors’ assumptions. Other model outputs, such as unadjusted survival and cancer deaths prevented with screening, were also reported but were not combined with the costs. The benefits were discounted at an annual rate of 3%.

Direct costs
The analysis of the costs was performed from a societal perspective. It included the direct medical costs of screening with or without biopsy, oesophagectomy, endoscopic palliation and post-surgical care. The unit costs were not presented separately from the resource quantities. The costs were estimated from published studies and 2005 data from the Centers for Medicare and Medicaid Services. Resource use was based on authors’ opinions and some published studies. Discounting was relevant, as the long-term costs were evaluated, and an annual rate of 3% was used. The price year was not explicitly stated but some costs were derived from 2005 sources.

Statistical analysis of costs
The costs and quantities appear to have been treated deterministically.

Indirect Costs
Productivity costs were included in the analysis, which was appropriate given the societal perspective adopted. Days of work missed because of screening were based on authors’ opinions. The cost to society of lost productivity for patients undergoing screening and their driver was based on national median income values. Other details on the assessment of productivity costs were not reported.

Currency
US dollars ($).

Sensitivity analysis
One-way and multi-way sensitivity analyses were performed on all model inputs in order to evaluate the robustness of the cost-utility ratios. Published ranges of values appear to have been used.
Estimated benefits used in the economic analysis
The expected LYs over the model's time horizon (30 years) were 23.19 with no screening, 23.51 with conventional EGD and 23.47 with capsule screening.

The expected QALYs over the model's time horizon (30 years) were 16.47 with no screening, 16.66 with conventional EGD and 16.64 with capsule screening.

With no screening, the number of death due to EAC was 356 out of 10,000 patients.

Cost results
The total costs per patient were $102 with no screening, $2,304 with conventional EGD and $2,348 with capsule screening.

Synthesis of costs and benefits
Incremental cost-utility ratios were calculated in order to combine the costs and benefits of the alternative strategies.

The incremental cost per QALY gained with conventional EGD over no screening was $11,254.

The incremental cost per QALY gained with capsule screening over no screening was $13,208.

Similar benefits and costs were achieved when the two screening strategies were compared, although conventional EGD, which achieved slightly more QALYs (0.02) at slightly lower costs ($44), was the preferred option.

The sensitivity analysis showed the robustness of the base-case results, with conventional EGD being the most cost-effective strategy in almost all scenarios. If society were willing to pay $50,000 per QALY, then capsule screening would be preferred only if the income of the patient and driver were each greater than $280,682.

The multi-way sensitivity analysis indicated that EGD was often the most cost-effective or dominant strategy. In particular, it was found that if the sensitivity and specificity of capsule screening were each 100% then the cost of the capsule would need to be less than $656 to be cost-effective with a willingness-to-pay threshold of $250,000 per QALY. Corresponding figures with willingness-to-pay thresholds of $100,000 and $50,000 per QALY were $624 and $613, respectively.

Authors' conclusions
Screening for Barrett's oesophagus (BE) with either conventional optical oesophagogastroduodenoscopy (EGD) or oesophageal capsule endoscopy (ECE) led to similar clinical and economic outcomes and were cost-effective in comparison with no screening. EGD was the preferred strategy in most of the scenarios analysed.

CRD COMMENTARY - Selection of comparators
The rationale for the selection of the comparators was clear as the authors considered both the conventional approach and the innovative screening strategy. The option of no screening was considered only for comparative purposes. However, the authors noted that EGD cannot be considered as the ‘gold’ standard, owing to the imperfections of EGD diagnosis. You should decide whether they are valid comparators in your own setting.

Validity of estimate of measure of effectiveness
The effectiveness data came from a published review of the literature. Thus, no information on the inclusion criteria, study design, patient population, or the interventions under examination was provided. This limits the possibility of evaluating the validity of the primary studies. It was noted that some data on the effectiveness of EAC screening came from observational studies, which have several biases. Other data were based on authors’ assumptions, owing to a lack of published data.
Validity of estimate of measure of benefit
The use of QALYs as the summary benefit measure was appropriate since they capture the impact of the intervention on two key dimensions of health (i.e. survival and quality of life) which are relevant for patients at risk of developing EAC. Further, QALYs can be compared with the benefits of other health care interventions. Discounting was performed, as routinely recommended. No information on the sources of the utility weights was provided and some estimates were based on author consensus.

Validity of estimate of costs
The analysis of the costs was consistent with a societal perspective. All the relevant categories of costs appear to have been included. The sources of the costs were reported for all items. Most of the costs were estimated using data from third-party payers in the USA. Resource consumption was mainly based on authors' opinions. Statistical analyses of the costs and quantities were not reported, but the impact of variations in the economic data was tested in the sensitivity analysis. The price year was not reported, which will make reflation exercises in other time periods difficult.

Other issues
The authors did not compare their findings with those from other studies. They also did not explicitly address the issue of the generalisability of the study results to other settings. However, the extensive use of sensitivity analysis enhances, to some extent, the external validity of the study. The authors acknowledged that it was not possible to incorporate patient preferences in the estimation of utility weights. However, a recent study showed that patients generally preferred being evaluated by ECE rather than EGD. The authors also noted that an area of uncertainty is represented by the issue of adherence with screening and surveillance for EAC, but patients generally adhered more with ECE than with EGD. If these factors had been included in the study, then ECE might have produced more QALYs than EGD and might have been more cost-effective.

Implications of the study
The study results support the implementation of screening for EAC in patients at high risk. Further studies should compare EGD with ECE and give more attention to patient preferences.

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MeSH
Adenocarcinoma /prevention & control; Aged; Aged, 80 and over; Analysis of Variance; Barrett Esophagus /diagnosis /epidemiology; Capsule Endoscopy /economics /methods; Cohort Studies; Cost-Benefit Analysis; Esophageal Neoplasms /prevention & control; Esophagoscopy /economics /methods; Gastroesophageal Reflux /diagnosis /epidemiology; Humans; Incidence; Male; Markov Chains; Mass Screening /economics /methods; Middle Aged; Quality-Adjusted Life Years; Sensitivity and Specificity; Survival Analysis

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