Screening and surveillance for Barrett esophagus in high-risk groups: a cost-utility analysis

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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 screening and surveillance of patients with symptoms of gastro-oesophageal reflux disease for Barrett’s oesophagus and adenocarcinoma was under consideration. Two strategies were examined. Both strategies used screening endoscopy at 50 years of age and biopsy to confirm Barrett’s oesophagus if abnormalities were seen at endoscopy. The first strategy limited surveillance to an endoscopy undertaken every 6 months for patients with Barrett’s oesophagus and low-grade dysplasia, and every 3 months for patients with Barrett’s oesophagus and high-grade dysplasia. The second strategy, a comprehensive surveillance strategy, comprised the limited surveillance strategy plus an endoscopy every 5 years for patients with Barrett’s oesophagus but no dysplasia.

Type of intervention
Screening.

Economic study type
Cost-utility analysis.

Study population
The study population comprised white men aged 50 with symptoms of gastro-oesophageal reflux disease. This group was considered at high risk on the basis of epidemiologic evidence that demonstrated an increased risk for oesophageal adenocarcinoma compared with other groups.

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

Dates to which data relate
The clinical effectiveness data and resource use data were derived from studies published between 1976 and 2001. The price year appears to have been 2001.

Source of effectiveness data
The effectiveness data were derived from a review or synthesis of completed studies. Estimates of effectiveness were based on opinion.

Modelling
A Markov model was used to model the clinical impact and resource use implications of the two screening strategies and the do nothing strategy. The time horizon was 50 years of age until 80 years of age or death.

Outcomes assessed in the review
The following model input parameters were identified from the review of primary studies:

- the prevalence of Barrett's oesophagus, low-grade dysplasia, high-grade dysplasia, and cancer in Barrett's oesophagus;
- the annual rates of progression from no dysplasia to low-grade dysplasia, from no dysplasia to high-grade dysplasia, from low-grade to high-grade dysplasia, from no dysplasia to cancer, from low-grade dysplasia to cancer, and from high-grade dysplasia to cancer;
- the annual rates of regression;
- the probability of resectability in patients;
- the rates of surgical mortality, cure of cancer, death from all other causes than unresectable cancer, and complications of endoscopy (death and other complications);
- endoscopy and biopsy findings (listed as actual state/diagnosed state) for no dysplasia/low-grade dysplasia, for low-grade dysplasia/no dysplasia, for low-grade dysplasia/high-grade dysplasia, for high-grade dysplasia/low-grade dysplasia, for cancer/low-grade dysplasia, and for cancer/high-grade dysplasia; and
- the utility of post-oesophagectomy state.

**Study designs and other criteria for inclusion in the review**
Not reported.

**Sources searched to identify primary studies**
The authors searched MEDLINE and EMBASE databases from 1970 to 2001, and the abstracts from major gastroenterological scientific meetings (1999 to 2001).

**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**
The model input parameters were identified from approximately 46 studies.

**Methods of combining primary studies**
Not reported.

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

**Results of the review**
The following model input parameters were identified from the review of primary studies:

- the prevalence of Barrett's oesophagus was 0.1;
the prevalence of low-grade dysplasia was 0.01;
the prevalence of high-grade dysplasia was 0.007;
the prevalence of cancer in Barrett's oesophagus was 0.067;
the annual rate of progression from no dysplasia to low-grade dysplasia was 0.05;
the annual rate of progression from no dysplasia to high-grade dysplasia was 0.01;
the annual rate of progression from low-grade dysplasia to high-grade dysplasia was 0.05;
annual rate of progression from no dysplasia to cancer was 0.005;
the annual rate of progression from low-grade dysplasia to cancer was 0.025;
the annual rate of progression from high-grade dysplasia to cancer was 0.055;
the annual rate of regression from Barrett's oesophagus to normal was 0.0175;
the annual rate of regression from low-grade dysplasia to no dysplasia was 0.63;
the annual rate of regression from high-grade dysplasia to no dysplasia was 0.1;
the annual rate of regression from high-grade dysplasia to low-grade dysplasia was 0.07;
the probability of resectability was 0.5 in unscreened patients and 0.95 in screened patients;
the rate of surgical mortality was 0.05 in unscreened patients and 0.027 in screened patients;
the rate of cure of cancer was 0.2 in unscreened patients and 0.8 in screened patients;
the rate of death from all other causes than unresectable cancer was variable;
the rate of death from endoscopy was 0.000021 and from other complications 0.0013;
endoscopy and biopsy findings (listed as actual state/diagnosed state), for no dysplasia/low-grade dysplasia 0.145;
endoscopy and biopsy findings, for low-grade dysplasia/no dysplasia 0.175;
endoscopy and biopsy findings, for low-grade dysplasia/high-grade dysplasia 0.083;
endoscopy and biopsy findings, for high-grade dysplasia/low-grade dysplasia 0.115;
endoscopy and biopsy findings, for cancer/low-grade dysplasia 0.05;
endoscopy and biopsy findings, for cancer/high-grade dysplasia 0.175; and
the utility of post-oesophagectomy state was 0.97.

Methods used to derive estimates of effectiveness
Where a model input parameter could not be identified from the literature, the authors made assumptions following a consensus of opinion.

Estimates of effectiveness and key assumptions
The authors identified the following model input parameters:

death from unresectable cancer, 0.9;

annual rate of progression for the development of Barrett's oesophagus, 0.005;

endoscopy and biopsy findings (listed as actual state/diagnosed state), for normal/Barrett's oesophagus 0.01;

diagnosis
edoscopy and biopsy findings, for normal/low grade-dysplasia 0.005;

diagnosis
edoscopy and biopsy findings, for normal/high-grade dysplasia 0.005;

diagnosis
edoscopy and biopsy findings, for no dysplasia/high-grade dysplasia 0.01;

diagnosis
edoscopy and biopsy findings, for no dysplasia/cancer 0.01;

diagnosis
edoscopy and biopsy findings, for low-grade dysplasia/cancer 0.05;

health utility of cancer, 0.5.

Measure of benefits used in the economic analysis
The measure of health benefit used was the quality-adjusted life-years (QALYs). The utility values were taken from two published studies. The first study derived utilities from expert opinion using the time trade-off technique, or assumptions made by the authors. The second derived utilities from responses by patients who had undergone oesophagectomy for high-grade dysplasia or cancer. The time horizon was 30 years or until death, whichever was the longer. The health benefits were discounted at a rate of 3% per annum.

Direct costs
The direct costs of a third-party health care purchaser were included in this analysis. These direct costs were for endoscopy with biopsies, oesophagectomy, endoscopy palliation, annual post-surgical care, care of incurable cancer and clinic visits. The costs and the quantities were not reported separately. The resource use data were derived from the model that provided the clinical effectiveness data. The cost data were taken from published studies and 2001 data from the Health Care Financing Administration. The costs were discounted at a rate of 3% per annum. The price year appears to have been 2001.

Statistical analysis of costs
No statistical analysis of the costs was undertaken.

Indirect Costs
No indirect costs were included in the analysis.

Currency
US dollars ($).

Sensitivity analysis
One-way sensitivity analyses and a Monte Carlo analysis were undertaken to assess the impact of variability in the data. Where possible, the ranges were taken from the literature. If ranges were not available in the literature, baseline values were halved and doubled to provide parameters for the sensitivity analysis.
Estimated benefits used in the economic analysis
The limited surveillance strategy and the more comprehensive screening strategy yielded 16.624 QALYs per patient, compared with 16.466 QALYs per patient under the do nothing strategy.

Cost results
The limited surveillance strategy cost $1,748 per patient and the more comprehensive strategy cost $2,053 per patient, compared with $104 per patient under the do nothing strategy.

Synthesis of costs and benefits
The incremental cost-effectiveness ratio (ICER) of the limited surveillance strategy compared with the do nothing strategy was $10,440 per QALY saved.

The ICER of the more comprehensive surveillance strategy compared with the limited surveillance strategy was $596,000 per QALY saved.

The ICER for surveillance intervals more frequent than every 5 years was consistently greater than $380,000 per QALY saved.

The sensitivity analysis showed that several variables altered the cost-effectiveness ratios by more than 25%. These were the probability of cure from cancer with oesophagectomy, the incidence of cancer, and the prevalence of Barrett's oesophagus and of cancer.

The annual incidence of adenocarcinoma would have to exceed 1 case per 54 patient-years of follow-up (1.9%) for surveillance of Barrett's oesophagus without dysplasia every 5 years to yield an ICER of less than $50,000 per QALY saved.

None of the sensitivity analyses altered the rank order of the strategies.

Authors' conclusions
Screening 50-year-old men with symptoms of gastro-oesophageal reflux disease, to detect cancer associated with Barrett's oesophagus, was cost-effective. However, subsequent surveillance of patients with Barrett's oesophagus but no dysplasia was not cost-effective.

CRD COMMENTARY - Selection of comparators
The authors compared their two screening strategies with a do nothing approach. You should consider how this relates to current practice in your setting prior to applying the results of this study.

Validity of estimate of measure of effectiveness
The clinical effectiveness evidence used in this paper was derived from a model. The model input parameters were, where possible, taken from a clearly reported review of published studies or the authors' assumptions. The paper did not indicate whether a systematic review was undertaken to identify the primary studies. However, the data sources and the search strategy used were detailed. No details were provided of any quality criteria applied to select the primary studies. The paper did not indicate how the estimates of model parameters from more than one primary study were combined, and whether this took account of varying sample sizes. The authors did not comment on possible reasons for differences between the primary studies. Where a model parameter could not be identified from published studies, the value was assumed by the authors. No details of any methods used, or discussions between the authors, were reported. It is therefore difficult to comment on the appropriateness and validity of these values.

Validity of estimate of measure of benefit
The measure of health benefit used in the economic analysis was taken from the model that provided the clinical effectiveness data. Valuations of the differing health states were either taken from published studies or assumed by the authors. The paper stated that patient preferences were used in the published studies. However, the methods used to assess the varying health states were not indicated. There were no details of the methods the authors used to arrive at their assumptions.

**Validity of estimate of costs**
The paper assessed the direct costs of a third-party health care purchaser. The paper provided a breakdown of the types of cost incurred and all appropriate costs appear to have been included. However, the costs and the quantities were not reported separately, which will hamper the generalisability of the authors' results to other settings. Future costs were appropriately discounted to reflect the preference for current benefit. The price year appears to have been 2001. However, this was not clearly stated and it was unclear whether costs taken from studies published before this date were reflated to the same year. A comprehensive sensitivity analysis was undertaken to assess variability in the data. This increases the generalisability of the study findings.

**Other issues**
The authors presented their analysis in a comprehensive manner and their conclusions reflected their results. They compared their findings with those from other studies in the same area and commented on any differences between the studies. The main difference was that screening and surveillance were simultaneously examined in this study. The authors did not consider how their results could be generalised to other patient populations or settings. They did not report any further limitations to their study.

**Implications of the study**
The authors did not make any direct recommendations for changes to practice. However, they highlighted that further research is needed to identify groups at risk of Barrett's oesophagus and cancer of the oesophagus, and to decrease the cost of screening methods.

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**Other publications of related interest**

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