Which colon cancer screening test: a comparison of costs, effectiveness, and compliance
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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
Several strategies for colon cancer screening were examined. These were faecal occult blood testing (FOBT) alone, FOBT combined with flexible sigmoidoscopy, flexible sigmoidoscopy alone, and colonoscopy.

Type of intervention
Screening.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised the general population of patients aged older than 50 years. Further inclusion and exclusion criteria were not reported.

Setting
The setting was not explicitly stated, but it appears to have been a hospital. The economic study was carried out in the USA.

Dates to which data relate
The effectiveness evidence and resource use data were derived from studies published between 1961 and 1999. The price year was 1999.

Source of effectiveness data
The effectiveness evidence was derived from a review of published studies, augmented by the authors’ assumptions.

Modelling
A Markov decision model was constructed to simulate the natural history of colorectal cancer. The model was mainly populated with data derived from the literature.

Outcomes assessed in the review
The outcomes assessed from the literature and used as inputs for the model were:

the proportion of cancers arising from polyps;

the prevalence of adenomatous polyps at different ages;

the proportion of polyps greater than 1 cm;
the proportion of multiple polyps in patients with polyps;
the annual incidence of colorectal cancer at different ages;
5-year colorectal cancer mortality (localised, regional, disseminated);
the sensitivity and specificity of FOBT for polyps;
the sensitivity of FOBT for localised or regional cancer;
polyps or cancer reachable by flexible sigmoidoscopy;
the sensitivity of flexible sigmoidoscopy or colonoscopy for cancer or polyps;
the perforation rate with colonoscopy; and
the mortality rate with perforation.

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

Sources searched to identify primary studies
Not stated.

Criteria used to ensure the validity of primary studies
Not stated.

Methods used to judge relevance and validity, and for extracting data
Not carried out.

Number of primary studies included
The effectiveness evidence were obtained from 32 primary studies.

Methods of combining primary studies
Narrative methods were used to combine the studies.

Investigation of differences between primary studies
Not carried out.

Results of the review
The proportion of cancers arising from polyps was 75% (range: 50 - 100).

The prevalence of adenomatous polyps was 20% (range: 10 - 30) at 50 years, 40% (range: 30 - 50) at 60 years, 50% (range: 40 - 60) at 70 years, and 55% (range: 45 - 65) at 80 years.

In patients with polyps, the proportion of polyps greater than 1 cm was 15% (range: 5 - 25) and the proportion of multiple polyps was 35% (range: 25 - 45).
The annual incidence of colorectal cancer was 0.05% at 50 years, 0.09% at 55 years, 0.14% at 60 years, 0.20% at 65 years, 0.27% at 70 years, 0.35% at 75 years, 0.43% at 80 years, and 0.45% at 85 years.

The 5-year colorectal cancer mortality was 10.5% for localised, 35.1% for regional, and 91.7% for disseminated cancer.

The sensitivity of FOBT for polyps was 5% (range: 2 - 10) and the specificity was 97.5% (range: 90 - 100).

The sensitivity of FOBT was 30% (range: 20 - 40) for localised cancer and 50% (range: 40 - 60) for regional cancer.

The percentage of polyps or cancer reachable by flexible sigmoidoscopy was 55% (range: 40 - 75).

The sensitivity of flexible sigmoidoscopy or colonoscopy was 85% (range: 80 - 95) for cancer and 95% (range: 90 - 100) for polyps.

The perforation rate with colonoscopy was 0.1% (range: 0.0 - 0.3).

The mortality rate with perforation was 7.5% (range: 5 - 10).

**Methods used to derive estimates of effectiveness**

The authors made some assumptions that were used to model the effectiveness evidence.

**Estimates of effectiveness and key assumptions**

The authors assumed that it took 10 years for a polyp to transform from benign to malignant. In addition, they assumed that it took 2 years to progress through localised cancer and an additional year to progress through regional cancer.

**Measure of benefits used in the economic analysis**

The measure of benefit was the life expectancy gained with each screening strategy. This was calculated using the Markov model and was discounted at a rate of 3%.

**Direct costs**

A 3% discount rate was used since the lifetime costs were calculated in the economic analysis. The unit costs were given. The cost items included in the analysis were the screening tests, polypectomy and procedural complications, and cancer care. The cost/resource boundary adopted was that of the third-party payer. The costs were mainly estimated from Medicare reimbursement rates and a few published studies. The quantities of resources were estimated using data from studies published between 1961 and 1999. All the costs were inflated to 1999 using the medical care consumer price index.

**Statistical analysis of costs**

Statistical analyses of the costs were not carried out.

**Indirect Costs**

The indirect costs were not included in the analysis.

**Currency**

US dollars ($).

**Sensitivity analysis**

One-way and multi-way sensitivity analyses were carried out to determine the impact of different variables on the cost-effectiveness estimates.
effectiveness of the screening strategies. Each variable in the model was tested in the one-way analysis. Those variables that had the greatest effects were then varied in the multi-way analyses. The discount rate was also varied (range: 0 - 6%).

**Estimated benefits used in the economic analysis**

The model predicted that the lifetime risk of colorectal cancer was 5.9% (5,869 cancers per 100,000 patients).

Assuming a 100% compliance rate, the average gain in life expectancy was 12.5 days with flexible sigmoidoscopy, 12.6 days with colonoscopy at age 60 years, 14.6 days with colonoscopy at age 55 years, 16.5 days with FOBT, 17.6 days with colonoscopy at ages 55 and 65 years, 18.8 days with colonoscopy at ages 50 and 60 years, and 20.7 days with flexible sigmoidoscopy and FOBT.

The average gain in life expectancy ranged from 8 to 15.8 days when assuming a 75% compliance rate, from 5.8 to 11.4 days when assuming a 50% compliance rate, and from 1.6 to 6.1 days when assuming a 25% compliance rate.

**Cost results**

The cost of no screening was $1,300.

Assuming a 100% compliance rate, the average cost was $1,930 with flexible sigmoidoscopy, $1,310 with colonoscopy at age 60 years, $1,420 with colonoscopy at age 55 years, $1,550 with FOBT, $1,540 with colonoscopy at ages 50 and 60 years, $1,750 with colonoscopy at ages 50 and 60 years, and $2,280 with flexible sigmoidoscopy and FOBT.

The average cost ranged from $1,310 to $1,840 when assuming a 75% compliance rate, from $1,310 to $1,590 when assuming a 50% compliance rate, and from $1,300 to $1,470 when assuming a 25% compliance rate.

**Synthesis of costs and benefits**

The costs and benefits of the screening strategies were combined using an incremental cost-effectiveness analysis. All of the strategies were cost-effective in comparison with no screening, at less than $20,000 per life-year saved. Regardless of the compliance level, flexible sigmoidoscopy alone and FOBT alone were dominated by colonoscopy (more effective and less costly). Each strategy was also compared with the immediate less effective strategy, assuming a compliance rate of 100%. The resultant incremental cost per added life-year gained was $130 with colonoscopy at age 60 years, $20,770 with colonoscopy at age 55 years, $14,870 with colonoscopy at ages 55 and 65 years, $62,140 with colonoscopy at ages 50 and 60 years, and $106,860 with flexible sigmoidoscopy and FOBT. The results were generally similar with the other levels of compliance. The exceptions were flexible sigmoidoscopy and FOBT, which were dominated with compliance levels of 50% and 25%, and colonoscopy at age 55 years, which was dominated with compliance levels of 25%.

The sensitivity analyses showed that the estimated cost-effectiveness ratios were affected by the discount rate, cost of colonoscopy, proportion of cancers arising from polyps, and compliance.

**Authors' conclusions**

Colonoscopy proved to be a cost-effective screening strategy under several compliance levels.

**CRD COMMENTARY - Selection of comparators**

The rationale for the choice of the comparators was clear. No screening was selected as the basic comparator, to permit the active value of the intervention to be assessed. The strategies studied were selected as representing available screening alternatives for the detection of colorectal cancer. The authors stated that barium enema as a screening option was not included in the analysis, due to its low sensitivity for polyps. You should assess whether they represent widely used health interventions in your own setting.
Validity of estimate of measure of effectiveness
The analysis of effectiveness used data obtained from the literature. However, the method used to combine the primary studies was not reported. Neither was it reported whether the author took into account differences in the sample size and study populations. The authors also made some assumptions. The authors stated that the effectiveness of endoscopic screening had not been demonstrated in randomised studies. To assess the robustness of the study results, and therefore enhance the validity of the results, several sensitivity analyses were carried out on the effectiveness data used in the model.

Validity of estimate of measure of benefit
The benefit measure used in the economic analysis was the number of life-years gained with each strategy. This was derived from a decision model, which appears to have been appropriate to simulate the natural history of the disease.

Validity of estimate of costs
The perspective adopted in the study was that of the third-party payer. It would appear that all the relevant categories of costs were included in the analysis. The indirect costs were not included in the analysis, but the authors stated that their impact should be similar with all of the screening strategies. The unit costs were reported and appropriate discounting was carried out. The selected discount rate was varied in the sensitivity analysis. The price year was reported.

Other issues
The authors compared their findings with those from other studies. The issue of the generalisability of the study results to other settings was not explicitly addressed, but sensitivity analyses were carried out. The study results were reported in detail and appear to be generalisable to the general population. The authors noted some limitations of the analysis, which have been highlighted already.

Implications of the study
From the results of this study, the authors suggested that it is important “to focus on developing strategies that optimise compliance or on adopting strategies that maintain a reasonable degree of cost effectiveness regardless of compliance”. In terms of clinical practice, the use of colonoscopic screening for colorectal cancer is preferable to the standard practice option examined.

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MeSH
Aged; Aged, 80 and over; Colonic Neoplasms /diagnosis /economics /mortality; Colonoscopy /economics; Cost-Benefit Analysis /economics; Decision Support Techniques; Guideline Adherence /economics; Humans; Markov Chains; Occult Blood; Sensitivity and Specificity; Sigmoidoscopy /economics; Survival Analysis