Health technology
Five alternative screening strategies for colorectal cancer (CRC) were compared with no screening. The strategies were:

- biennial faecal occult blood testing (FOBT) for individuals aged 50 to 69 years;
- biennial FOBT for individuals aged 60 to 69 years;
- once only flexible sigmoidoscopy (FSIG) for individuals aged 55 years;
- once only FISG for individuals aged 60 years; and
- once only FSIG for individuals aged 60, followed by biennial FOBT for individuals aged 61 to 70 years.

Type of intervention
Screening.

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

Study population
The study population comprised a hypothetical cohort of 100,000 individuals from the general population in England without polyps or cancer.

Setting
The setting was secondary care. The economic analysis was carried out in the UK.

Dates to which data relate
The effectiveness data used to populate the model came from studies published between 1961 and 2003. The price year appears to have been 2003.

Source of effectiveness data
The clinical parameters associated with the model included:

- transition probabilities for the different stages,
- test specificities and sensitivities,
- natural history parameters,
CRC incidence,
mortality,
recurrence rates,
harm parameters, and
screening participation rates.

Modelling
A state transition model, which consisted of three interlinked sub-models, was developed. The three models simulated:
the natural history of CRC;
screening and subsequent surveillance - which interacts directly with the natural history; and
mortality, including age-specific, other cause, CRC-related, and perforation due to endoscopic procedures.

Full details of the model and their interactions were presented in the paper. In addition, a supplementary appendix was made available (http://gut.bmj.com/supplemental).

Sources searched to identify primary studies
The clinical effectiveness data were derived from published studies. Whist it is apparent from the reporting that a number of UK sources had been used, the details of individual trials were not presented.

Methods used to judge relevance and validity, and for extracting data
The methods used to identify and select the data used to populate the model were not reported. No inclusion criteria were specified for any of the parameters.

Measure of benefits used in the economic analysis
The measures of benefit used were the life-years gained (LYGs) and the quality-adjusted life-years (QALYs). The utility weights were derived from a published study. The benefits were discounted at a rate of 3.5%.

Direct costs
The study considered two groups of costs, those associated with the screening programme and those associated with the diagnosis, treatment and follow-up of CRC. The resource quantities were reported separately from the unit costs. The resource data were obtained from the literature and expert opinion. The price data were obtained from the NHS Reference Costs, from published studies and from clinical expert opinion. The costs were discounted at an annual rate of 3.5%. The price year appears to have been 2003.

Statistical analysis of costs
The quantities and costs were treated stochastically.

Indirect Costs
Inline with the perspective adopted, no productivity losses were included.

Currency
UK pounds sterling.

**Sensitivity analysis**
Variability in the data was explored. A one-way sensitivity analysis was undertaken to explore the impact of changing individual values for cost and participation parameters on central estimates of cost-effectiveness. A probabilistic sensitivity analysis was carried out to evaluate parameter uncertainty. Each variable was assigned a distribution and Monte Carlo simulations were performed.

**Estimated benefits used in the economic analysis**
The incremental LYGs for the five screening strategies versus the no screening option were 0.026 for biennial FOBT at age 50 - 69 years, 0.0126 biennial FOBT at age 60 - 69 years, 0.0237 for FSIG once at age 55 years, 0.0197 for FSIG once at age 60 years, and 0.0271 for biennial FOBT at age 61 - 70 years.

The incremental QALYs of screening versus no screening were 0.0227 for biennial FOBT at age 50 - 69 years, 0.0104 for biennial FOBT at age 60 - 69 years, 0.027 for FSIG once at age 55 years, 0.0221 for FSIG once at age 60 years, and 0.0282 for FSIG once at age 60 years and biennial FOBT at age 61 - 70 years.

**Cost results**
The marginal cost of the five screening strategies versus the no screening option was 66.95 for biennial FOBT at age 50 - 69 years, 24.53 for biennial FOBT at age 60 - 69 years, -28.77 for FSIG once at age 55 years, -28.51 for FSIG once at age 60 years, and -1.92 for FSIG once at age 60 years and biennial FOBT at age 61 - 70 years.

**Synthesis of costs and benefits**
The incremental cost per LYG for screening versus no screening was 2,576.72 for biennial FOBT at age 50 - 69 years and 1,950.29 for biennial FOBT at age 60 - 69 years.

The incremental cost per QALY for screening versus no screening was 2,949.64 for biennial FOBT at age 50 - 69 years and 2,364.99 for biennial FOBT at age 60 - 69 years.

FSIG once at age 55 years, FSIG once at age 60 years, and FSIG once at age 60 years followed by biennial FOBT at age 61 to 70 years were dominant.

The one-way sensitivity analysis showed that the greatest impact on cost-utility resulted from the use of alternative series of calibrated transition probabilities. The incremental cost per QALY for the best and worst sets ranged from 551 to 7,992 for biennial FOBT at age 50 - 69 years and from 15 to 6,111 for biennial FOBT at age 60 - 69 years. The probabilistic sensitivity analysis using a marginal cost-effectiveness plane showed that all of the screening options would appear to be economically attractive in comparison with a policy of no screening. FSIG offered to individuals aged between 50 and 60 could always be expected to dominate the no screening option, while FOBT at age 60 - 69 years could always be expected to be more expensive and less effective than the once-only FSIG option.

**Authors' conclusions**
Screening using faecal occult blood testing (FOBT) and/or flexible sigmoidoscopy (FSIG) is a potentially cost-effective strategy for the early detection of colorectal cancer (CRC).

**CRD COMMENTARY - Selection of comparators**
The rationale for the choice of the comparator was clear in that it represented standard practice for CRC screening in the UK. You should decide whether this represents current practice in your own setting.
Validity of estimate of measure of effectiveness
The authors combined data from published studies. No systematic search for data was reported, and whilst this is not uncommon in modelling papers it does mean that any evaluation of the validity of the effectiveness parameters is limited or impossible.

Validity of estimate of measure of benefit
Both LYGs and QALYs are valid measures of benefit that permit comparisons with the benefits of other health care interventions. The estimation of benefits was modelled using a state transition model. The utility weights were estimated using the standard gamble method, which is considered to be methodologically superior.

Validity of estimate of costs
The analysis of the costs was consistent with the perspective adopted in this study, although a more detailed breakdown of the costs would have been more informative. It was not possible to judge the validity of the data given the information reported in this paper (more information can be found in Atkin et al. 2002 and Whynes et al. 2003, see 'Other Publications of Related Interest' below for bibliographic details).

Other issues
The authors did not make comparisons of their findings with those of other studies. They acknowledged some limitations of their model. First, the estimates of adenoma prevalence might not reflect current prevalence rates in England. Second, the absence of direct evidence on the rates of transition between disease states meant that several of the model parameters had to be fitted to published data. Third, the model assumed that all cancers derive from pre-existing adenomas, which favoured all screening options. Finally, the evidence concerning the sensitivity of FOBT is weak. Sensitivity analyses identified key areas of uncertainty, which goes some way towards addressing the issue of the generalisability of the study results to other settings. The results of the study do not appear to have been presented selectively and the authors' conclusions appear to be an adequate reflection of the scope of the analysis.

Implications of the study
The study suggests that screening for CRC using FOBT and/or FSIG may provide health gains at a cost which is acceptable to NHS policy-makers, but the authors pointed out that consideration of resource constraints should be made prior to the roll-out of any of these screening options.

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Other publications of related interest
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