Cost effectiveness of CT colonography for UK NHS colorectal cancer screening of asymptomatic adults aged 60-69 years

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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.

CRD summary
This study investigated the cost-effectiveness of computed tomography colonography compared with faecal occult blood testing, flexible sigmoidoscopy, and optical colonoscopy for the detection of colorectal cancer in asymptomatic individuals aged 60 to 69 years. The authors concluded that computed tomography colonography was potentially cost-effective, compared with the other options, but considerable uncertainty existed. With a few exceptions, the methods were transparent and clearly reported and the conclusions reached by the authors reflect the scope of their analysis.

Type of economic evaluation
Cost-effectiveness analysis, cost-utility analysis

Study objective
The aim was to assess the cost-effectiveness of computed tomography (CT) colonography for colorectal cancer screening, using a hypothetical cohort of asymptomatic individuals aged 60 to 69 years.

Interventions
CT colonography was compared with faecal occult blood testing (FOBT), flexible sigmoidoscopy, and optical colonoscopy. The screening frequency was every two years for FOBT and every 10 years for the other three options. Following a positive screening test, optical colonoscopy and polypectomy was performed for FOBT and CT colonography, while polyp removal occurred during the screening procedure for flexible sigmoidoscopy and optical colonoscopy.

Location/setting
UK/out-patient care.

Methods
Analytical approach:
A Markov health state transition model was used to synthesise the published data from various sources that included key randomised controlled trials, such as Johnson, et al. 2008 (see 'Other Publications of Related Interest' below for bibliographic details), and epidemiological and national reports. The analysis was based on a published model, with updates for many of the data inputs, (Tappenden, et al. 2004, see 'Other Publications of Related Interest' below for bibliographic details). The analytic time-frame was the patient's lifetime and the authors stated that the perspective was that of the UK National Health Service (NHS).

Effectiveness data:
The effectiveness data were updated using cancer statistics reported by the Office of National Statistics and the model parameters were adjusted so that the outcomes were consistent with these statistics. The effectiveness of the four screening options was measured by the number of individuals with polyps, the cancers detected through screening, the symptomatic cancers diagnosed, the colorectal cancer-related deaths, the adverse events, and survival. The sensitivity and specificity were also important clinical outcomes (see Johnson, et al. 2008). The clinical event data were from a selection of relevant published studies.

Monetary benefit and utility valuations:
The health state values were based on primary data from a published study (Ness, et al. 1999, see 'Other Publications of Related Interest' below for bibliographic details).
Related Interest’ below for bibliographic details), which used the standard gamble method, with 90 patients. Values were obtained for five health states, which were no cancer, and Dukes’ stages A to D of cancer severity.

Measure of benefit:
The measure of benefit was quality-adjusted life-years (QALYs) and discounting was applied at an annual rate of 3.5%.

Cost data:
The resources included those for screening, treating adverse events, and cancer treatment. The unit costs were based on tariffs from Payment by Results, NHS reference costs, and major procedure codes for surgical interventions. The general patterns of care for patients with colorectal cancer were based on data from published studies and some assumptions. The administration costs for screening were assumed to be the same for the four options and were omitted. The costs were discounted at 3.5% and reported in 2007 prices. The currency used was UK pounds sterling (£).

Analysis of uncertainty:
The uncertainty was measured, using one-way sensitivity analyses on the key parameters, which were varied by ±20% if upper or lower estimates were not available, and the results were presented in a tornado diagram. Probabilistic sensitivity analysis was also undertaken. Beta distributions were assigned to all the proportions and probabilities, while log-normal distributions were used for the cost data. One thousand Monte Carlo simulations were run and 95% confidence intervals were generated. The results were illustrated on a cost-effectiveness plane. To assess the impact of using unit costs from Payment by Results tariffs, where possible, the model was also run using only NHS reference costs.

Results
The total discounted mean costs per patient were £434 for CT colonography, £445 for FOBT, £452 for flexible sigmoidoscopy, and £518 for optical colonoscopy. The total discounted mean QALYs per patient were 16.862 for CT colonography, 16.861 for flexible sigmoidoscopy, and 16.865 for optical colonoscopy.

CT colonography had lower costs and higher QALYs than FOBT and flexible sigmoidoscopy and dominated these options. Compared with FOBT (usual care), all screening options had incremental cost-effectiveness ratios well below £20,000 to 30,000. Compared with CT colonography, optical colonoscopy had an incremental cost per QALY of £34,002.

Screening uptake and the cost of screening had the strongest influences on the marginal cost-utility ratios for all screening options, but the ratios remained low. The results were robust to variations in the sensitivity of cancer detection and the probability and costs of adverse events associated with screening and polypectomy. The probabilistic sensitivity analyses indicated a 48% probability that the incremental cost per QALY for CT colonography would be less than £30,000, compared with FOBT, and a 5.9% probability that CT colonography would dominate FOBT.

Authors’ conclusions
The authors concluded that a colorectal screening programme, using CT colonography every 10 years, for 60- to 69-year-olds, was potentially cost-saving and more effective than the usual UK programme of biennial FOBT. They acknowledged that there was considerable uncertainty in the probabilistic sensitivity analyses and further research was needed on the effect of CT colonography screening on the NHS budget and capacity.

CRD commentary
Interventions:
The authors chose a range of screening options for colorectal cancer detection, which included the usual care, and they justified their selection. These options might be appropriate comparators in other settings.

Effectiveness/benefits:
The model type and its structure were clearly presented, along with all the inputs and data sources. Some of the key effectiveness parameters were from a previous study (Tappenden, et al. 2004), which will need to be consulted to assess their internal validity. For ethical reasons, only indirect evidence was available for the link between CT colonography and reduced mortality. The authors did not report a systematic review, nor a search strategy, to identify the data to
update the model parameters and the source of the effectiveness data, which makes it difficult to ascertain if all the relevant data was included. The utility values were measured using a small number of patients with adenomas removed; the methods and health states were briefly reported.

Costs:
The costs appear to have been appropriate for the perspective taken. Thorough details of the resource types and how these were valued were provided and, where assumptions were made, these were fully justified.

Analysis and results:
The model was adequately described and it appears that a full incremental cost-effectiveness analysis was undertaken. The authors reported a number of limitations to their study, including the uncertain optimal timing between CT colonography scans, the reliance on indirect evidence for the efficacy of CT colonography in reducing mortality, the model did not account for other beneficial findings nor harmful radiation exposure from scans, and assumptions were needed for the natural history of colorectal cancer. The authors evaluated the impact of data variability in thorough sensitivity analyses and appear to have presented the results comprehensively. They provided a detailed account of the generalisability of their findings and the research and policy implications.

Concluding remarks:
With the exception of some model simplifications and assumptions, the methods and analysis appear to have been appropriate and comprehensive. The conclusions reached by the authors reflect the scope of their analysis.

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Other publications of related interest


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