**Institution:** University of Sheffield

**Unit of Assessment:** 2 - Public Health, Health Services and Primary Care

**Title of case study:** Introduction of a national colorectal cancer screening programme

## 1. Summary of the impact

Research undertaken at the University of Sheffield in 2005 to evaluate the cost-effectiveness and resource implications of potential screening programmes for colorectal cancer informed the decision to launch a national colorectal cancer screening programme in England. Upon their 60th/61st birthday, all individuals in England are now invited to participate in biennial bowel cancer screening using faecal occult blood testing (FOBT) until the age of 74. The programme identifies individuals with less advanced colorectal cancer and there is emerging evidence that it has led to an overall improvement in prognosis. Projections suggest that the programme is on course to reduce colorectal cancer deaths by 16%.

Amongst others, follow-on research includes an options appraisal of screening in Ireland that has informed national policy and a re-appraisal of colorectal screening options following publication of a pivotal trial of flexible sigmoidoscopy (FSIG) screening for NHS Cancer Screening Programmes.

## 2. Underpinning research

Colorectal (bowel) cancer is the third most common cancer with more than 41,000 people diagnosed with the disease each year in the UK. Approximately 16,000 people die of colorectal cancer each year. Evidence suggests that colorectal cancer screening may reduce incidence, morbidity and mortality associated with the disease.

Between 2004 and 2005, the School of Health and Related Research (ScHARR) at the University of Sheffield undertook a Colorectal Cancer Screening Options Appraisal on behalf of NHS Cancer Screening Programmes and the Department of Health. The work was undertaken by a team led by Dr Paul Tappenden (Reader in Health Economic Modelling); other team members included Hannah Sakai (Research Assistant, left 2004), Simon Eggington (Research Associate, left 2006) and Jim Chilcott (Professor of Health Economics and Decision Modelling).

The objective of the project was to evaluate the cost-effectiveness and resource implications of potential screening programmes for colorectal cancer to inform decisions about whether the NHS should adopt a bowel cancer screening programme and, if so, which test modalities, population and frequency should form the basis of the programme.

The research study included a review of existing randomised trials of alternative screening modalities, a model-based health economic evaluation and an analysis of resource implications for alternative options.

The team developed a health economic model to simulate the life experience of a hypothetical cohort of individuals without polyps or cancer through to the development of adenomas and malignant carcinoma and subsequent death in the general population of England. The costs, health effects and resource impact of five screening options were evaluated using this model: (a) biennial FOBT for individuals aged 50–69; (b) biennial FOBT for individuals aged 60–69; (c) once-only FSIG for individuals aged 55; (d) once-only FSIG for individuals aged 60; and (e) once-only FSIG for individuals aged 60, followed by biennial FOBT for individuals aged 61–70.

Each option was compared in terms of expected health benefits (survival/quality-adjusted life years [QALYs] gained), costs and resource implications. The economic analysis suggested that screening using FSIG with or without FOBT was likely to produce cost-savings and additional health benefits compared against no screening. However, the accompanying resource use analysis suggested that the considerable endoscopy capacity requirements associated with the FSIG screening options may make them infeasible given capacity constraints.

The original work was presented by Dr Tappenden to the English Bowel Cancer Working Party and was later discussed in Parliament. The study was published as a peer-reviewed report which is hosted on the NHS Cancer Screening Programmes website. A series of subsequent peer-reviewed publications followed directly from this modelling work and from subsequent research projects initiated by the original options appraisal.

Following the options appraisal, several further related research projects have been undertaken by ScHARR using the bowel cancer screening model including:

- Department of Health – an assessment of early awareness campaigns for colorectal cancer
- Department of Health – re-appraisal of colorectal screening options following publication of the FSIG trial
- HIQA – an appraisal of colorectal cancer screening options in Ireland.

## 3. References to the research

R1. Tappenden P, Chilcott JB, Eggington S, Patnick J, Sakai H, Karnon J. Option appraisal of population-based colorectal cancer screening programmes in England. Gut 2007;56:677-684.

R2. Whyte S, Chilcott JB, Halloran S. Reappraisal of the options for colorectal cancer screening in England. Colorectal Disease 2012;14:e547-3561 doi: 10.1111/j.1463-1318.2012.03014.x

R3. Parkin DM, Tappenden P, Olsen AH, Patnick J, Sasieni P. Predicting the impact of the screening programme for colorectal cancer in the UK. Journal of Medical Screening 2008;15(4):163-74. doi: 10.1258/jms.2008.008024

R4. Sharp L, Tilson L, Whyte S, O'Ceilleachair A, Walsh C, Usher C, Tappenden P, Chilcott J, Staines A, Barry M, Comber H. Cost-effectiveness of population-based screening for colorectal cancer: a comparison of guaiac-based faecal occult blood testing, faecal immunochemical testing and flexible sigmoidoscopy. British Journal of Cancer 2012;106(5):805-816. (doi: 10.1038/bjc.2011.580)

R5. Pilgrim H, Tappenden P, Chilcott JB, Bending M, Trueman P. The costs and benefits of bowel cancer service developments using discrete event simulation. Journal of the Operational Research Society 2009;60:1305–1314. (doi: 10.1057/jors.2008.109)

## 4. Details of the impact

The research study was used to inform a policy decision to implement a national bowel cancer screening programme which in turn has led to improvements in the prognosis of patients with diagnosed bowel cancer (S6,S7). Whilst there is not yet direct evidence of patient benefit from the programme itself, other evidence suggests that earlier diagnosis is associated with improved survival (S7) and improved health-related quality of life (S8). Analyses from RCTs and the English bowel cancer screening programme indicate that screening results in earlier diagnosis, thus patient benefit is fully expected.

This research study provided the key evidence which was reviewed by the English Bowel Cancer Advisory Group in 2004 in formulating recommendations to the Secretary of State for Health for colorectal cancer screening in England (this can be corroborated by Professor Sir Mike Richards – See coversheet).The commissioning of this options appraisal was cited in Parliament in 2004 (S1) and its relationship to the policy decision is cited in advice to the NHS on bowel cancer screening

(S2).

The work was presented by Dr Tappenden to the English Bowel Cancer Advisory Group in 2004. In 2005, the Secretary of State for Health announced that a national screening programme involving FOBT for individuals aged 60-69 would be launched in England. The NHS Bowel Cancer Screening Programme launched an FOBT-based programme in 2006 and this is now fully rolled out across England.

This policy decision resulted in a substantial service change for the NHS requiring the establishment of whole new system infrastructures (screening hubs, laboratory testing etc.) and their integration with existing services for endoscopy. The screening programme is available to all men and women in England from the date of their 60th or 61st, birthday. An extension has recently been rolled out to include individuals up to the age of 74 years of age. The government is also planning to include an additional screening FSIG for individuals aged 55 years of age (S3). This policy option was re-evaluated retrospectively in a Department of Health funded project using the original ScHARR options appraisal model.

The introduction of a national screening programme has also changed the agenda for health intervention in this area, with a new focus on increasing participation in screening and promoting the earlier diagnosis of the disease.

At this time, it is difficult to assess the direct health impact of introducing bowel cancer screening in England as cancer incidence and mortality fluctuate year on year and other changes to the health system may account for some additional benefits. There is also a time lag in the availability of national mortality data from the Office for National Statistics.

There is, however, an evident trend towards increased incidence (~13% in the UK between 2006 and 2008) since the rollout of the programme; this reflects additional cases of preclinical cancer that would otherwise have been likely to have been diagnosed later, potentially at a more advanced stage. Research evidence from randomised controlled trials has shown that FOBT can reduce colorectal cancer mortality (approximately 16%) and that FSIG can reduce both incidence and mortality (23% and 31% respectively). Statistics from Cancer Research UK indicate that the mortality rate for bowel cancer in the period 2008-2010 was 14% lower than the rate in the period 1991-1999. It is likely that a proportion of this benefit is attributable to the introduction of the screening programme (http://www.cancerresearchuk.org/cancer-info/cancerstats/types/bowel/incidence/uk-bowel-cancer-incidence-statistics). The available evidence (see Section 5) indicates that the screening programme has had a positive impact upon the prognosis of patients with screen-detected colorectal cancer and a mortality reduction of approximately 16% is estimated on the basis of this evidence; this suggests around 2,500 colorectal cancer deaths are expected to be avoided each year (S5).

## 5. Sources to corroborate the impact

The benefits of colorectal cancer screening in reducing mortality have been demonstrated in randomised controlled trials, meta-analyses and pilot studies. There is now emerging evidence that the national bowel cancer screening programme is having a positive impact upon patient prognosis.

**References relating to policy decisions:**

S1. Commissioning of ScHARR options appraisal discussed in Parliament May 20th 2004 – available from http://www.publications.parliament.uk/pa/cm200304/cmhansrd/vo040520/text/40520w01.htm

S2. Direct link between options appraisal and policy decision discussed in NBCSP Bowel Cancer Advice to the NHS document – available from:

www.londongarc.nhs.uk/downloads.php?filename=313_DH_Advice_to_the_NHS.pdf

S3. Extension of screening programme to include flexible sigmoidoscopy. Parliamentary minutes – http://www.publications.parliament.uk/pa/cm201011/cmhansrd/cm111123/debtext/111123-0004.htm

**Press releases relating to benefit impact for patients and predicted economic benefits:**

S4. National Cancer Research Institute. "Bowel cancer screening reduces cancer deaths by more than 25%." NCRI Conference 2011. Available from:
http://conference.ncri.org.uk/archive/2011/press-releases/2011_09Nov_BOWEL_SCREENING.pdf

S5. English Bowel Cancer Screening Programme. "The NHSBCSP in England is on track to cut bowel cancer deaths by 16 per cent." 2011. Available from: www.cancerscreening.nhs.uk/bowel/news/010.html

**Peer reviewed publications relating to benefit impact & prognosis for patients:**

S6. Logan R et al. Outcomes of the Bowel Cancer Screening Programme (BCSP) in England after the first 1 million tests. Gut. 2012 October; 61(10): 1439–1446. Available from: www.ncbi.nlm.nih.gov/pmc/articles/PMC3437782/

S7. Morris E et al. A retrospective observational study examining the characteristics and outcomes of tumours diagnosed within and without of the English NHS Bowel Cancer Screening Programme. British Journal of Cancer (2012) 107, 757–764. Available from: www.nature.com/bjc/journal/v107/n5/abs/bjc2012331a.html

S8. Ness RM, Holmes AM, Klein R, Dittus R. Utility valuations for outcome states of colorectal cancer. American Journal of Gastroenterology 1999;94(6):1650-1657.

**Other statistics relating to impact:**

S9. Cancer Research UK lists sources of data: Between 2006 and 2008, bowel cancer European age-standardised incidence rates for people aged 60-69 increased by more than 12% in the UK (http://www.ons.gov.uk/ons/search)