ORIGINAL ARTICLE

Performance measures in three rounds of the English bowel cancer screening pilot

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ABSTRACT

Objectives To compare performance measures across all three rounds of the English bowel cancer screening faecal occult blood test pilot and their relation to social deprivation and ethnicity.

Methods In each round in three primary care trusts, data for a restricted population of over 48 500 aged 60—69 years were analysed. Individual-based data included postcode linked to area-based data on the Index of Multiple Deprivation (IMD) 2004, and ethnicity. Outcomes were the rates of screening and colonoscopy uptake, positivity and detection of neoplasia (adenomas or bowel cancer) and bowel cancer, and the positive predictive values (PPVs) of a positive test for neoplasia and bowel cancer. Sensitivity was calculated by the proportional incidence method using data on interval cancers identified from cancer registrations.

Results The overall uptake rate was 61.8%, 57.0% and 58.7% in the first, second and third rounds, respectively. Although the PPV for cancer decreased over the course of the three rounds (10.9% in the 1st round, 6.5% in 3rd round), the PPV for all neoplasia remained relatively constant (42.6% in 1st round, 36.9% in 3rd round). Deprivation and non-white ethnic background (principally Indian subcontinent in the pilot region) were associated with low screening and colonoscopy uptake rates, and this changed little over the three screening rounds. Uptake was lower in men, although differences in uptake between men and women decreased over time. Non-participation in previous rounds was a strong predictor of low uptake.

Conclusions Performance measures are commensurate with expectations in a screening programme reaching its third round of screening, but a substantial ongoing effort is needed, particularly to address the effects of deprivation and ethnicity in relation to uptake.

Significance of this study

What is already known about this subject?

- Screening using the faecal occult blood test (FOBt) can reduce mortality from bowel cancer.
- Pilots of FOBt screening in the UK have demonstrated that screening is feasible and acceptable—and measures of uptake, test performance and outputs seen in randomised controlled trials can be replicated in population screening.
- Factors such as age, gender, ethnic background and deprivation status strongly influence uptake of FOBt screening.

What are the new findings?

- Temporal trends for pathology detected and positive predictive value suggest that FOBt screening in UK populations follows patterns seen in other screening programmes.
- The effect of deprivation and ethnicity on uptake is resilient—there was little change over the course of three rounds in the pilot.
- Gender differences in uptake, which were quite marked at the start of the pilot, appear to decrease over time.
- 'Opt-in' strategies for older people, outwith the target age group, are unlikely to attract significant numbers of participants.

How might it impact on clinical practice in the foreseeable future?

- Ongoing and substantial efforts will be required to overcome inequalities in FOBt screening uptake.
- Key indicators such as test performance, pathology detected and uptake will require careful monitoring as FOBt screening becomes an embedded programme in the NHS.

The national bowel cancer screening programmes (NBCSPs) are now well established in all four countries of the UK. Before the introduction of the programmes, an extensive pilot study was conducted at two sites in England and Scotland[1]; the aim of this pilot was to establish whether the performance of the faecal occult blood test (FOBt) in randomised controlled trials of screening could be replicated in a population setting. Further information and quality systems were tested and found to be implementable at a population level. Three rounds were each conducted in Scotland and England. Results were reported separately for Scotland.[2] We have reported previously the results from the evaluation of the second round in England, demonstrating a lower uptake of screening compared with the first round, and documenting the significant workload implications for endoscopy services.[3]

However, the pilots also provide a unique opportunity to examine FOBt screening over three consecutive rounds. There is very little information to date on the dynamics of periodic FOBt screening, and the availability of data from three rounds of screening provides an opportunity to examine temporal trends. If bowel cancer screening is to be successful in the

UK, it is important to examine performance and outputs of screening over a prolonged period of time.

The aims of this paper are to compare performance measures across all three rounds of the English bowel cancer screening pilot, with reference to uptake of invitation, positive rates, uptake of colonoscopy, and rates of detection of neoplasia and cancer. Particular attention is paid to variations in outcome by social deprivation and ethnicity using area-based statistics derived from census data and linked to an individual's postcode.

METHODS

A full description of the screening pilot can be found in the evaluation reports for each round.[1 3–5] The primary care trusts (PCTs) taking part in all three rounds were Coventry, Rugby and North Warwickshire. The pilot was administered from the Bowel Cancer Screening Unit (the screening unit) at the Hospital of St Cross, Rugby.

In the first and second rounds of screening, all people aged 50–69 years in each PCT were invited to take part. In the third round, the age range was restricted to 57–69 years. In the first round, invitations for screening were sent out from September 2000, the second round from February 2003, and the third round from May 2005, with an intended 2-year interval between rounds. The distributions of the time interval between the first and second, and between the second and third round invitations had medians of 28 and 25 months, respectively.

Invitations were sent out, and test kits returned to the screening unit. The screening process used the HemaScreen Faecal Occult Blood kit, an unhydrated guaiac based test with six sample collection spots, to test for occult blood. Reading of a kit resulted in a negative (no spots positive), weak positive (one to four spots positive) or strong positive (five to six spots positive) result. A positive outcome was either a strong positive or a weak positive followed by a positive in a later phase (figure 1). There was no dietary restriction in phases 2 and 3 of the third round, in contrast with previous rounds. A more detailed flowchart of the invitation process and phases is given in online appendix A.

People with a positive FOBt outcome were offered an appointment with a screening nurse who provided information and answered any questions. If medically fit, they were referred for a colonoscopy. In the second round, if a patient had a colonoscopy in the first round, they were not invited, but were invited again in the third round. In the third round, this rule changed so that if a patient had a negative colonoscopy in the second round, they were still invited for screening.

Counts of neoplasia included people with either adenomas (at any level of risk) or cancer. The levels of adenoma risk were defined as:

- Low: one or two adenomas <10 mm
- Intermediate: either one or two adenomas with at least one >10 mm or three to four adenomas all <10 mm
- High: either three to four adenomas with at least one >10 mm or five or more adenomas.

A person was classified as having bowel cancer if there was pathological confirmation from either a resection specimen or a biopsy/polyp removed at colonoscopy. This definition includes polyp cancers, where the cancer was confined to one or more polyps. The analysis also included a few people whose cancer was advanced who received only palliative treatment (either chemotherapy or radiotherapy) without any surgery, and so no resection specimen was available to confirm the cancer.

The data for the evaluation were extracted from downloads from the pilot database.[1 5 6] Linkage of people across the three rounds was performed by matching on NHS number and month/year of birth. Information on screen-detected cancers was supplied in the download from the Pilot Screening Office. In addition, the West Midlands Cancer Intelligence Unit provided data on all registered cases of bowel cancer diagnosed in people in the pilot population, in order to study interval cancers (those diagnosed after a negative screening episode, and before the date of any subsequent invitation). The pilot site supplied a list of people to West Midlands Cancer Intelligence Unit for matching, in order to identify only those cases in the pilot population. Approval for this process was given by the Patient Information Advisory Group (PIAG 3-05(i)/2007).

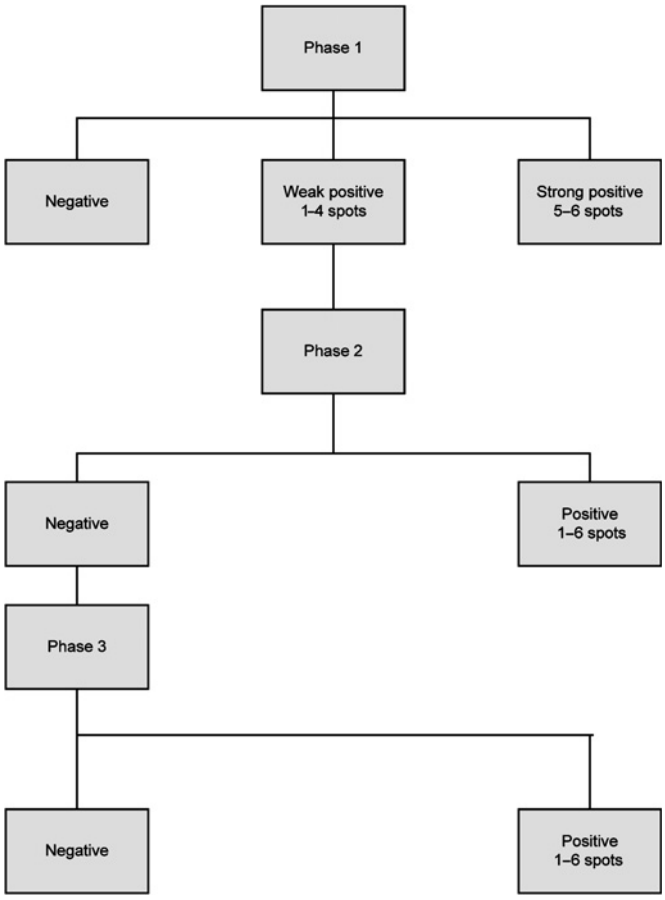

Figure 1 Screening process to give test result.

The analysis for each round was restricted to people invited in the age range 60–69 years, as this is the age range used in the NBCSP in England. In addition, South Warwickshire NHS Trust only participated in the first round of the pilot, and people in South Warwickshire PCT (except for two practices) were excluded from this analysis.

The following were excluded from the analyses:

- People from outside the three PCTs of Coventry, Rugby and North Warwickshire (n=23 725, 1960 and 27 for rounds 1, 2 and 3, respectively).
- People invited in the second and third rounds for the first time, who had probably moved into the study areas (n=1282 in round 2, and 2107 in round 3). These did not form a large enough group for analysis.
- People invited in the first and third rounds but not the second were excluded in the analysis of round 3 (n=789).

After these exclusions, there were a total of 49 311, 48 633 and 49 664 people aged 60–69 years invited in the first, second and third rounds, respectively.

Social deprivation was studied using the Index of Multiple Deprivation (IMD) 2004, obtained from the Office of the Deputy Prime Minister.[7] Each person in the screening pilot was linked by postcode to a super output area for which the IMD quintile was available. Ethnicity was studied using data from the 2001 census, obtained from the Census Dissemination Unit.[8] As the dominant ethnic minority in the pilot area was Indian subcontinent origin, this variable was included in the analyses. Indian subcontinent origin was defined as Indian, Pakistani, Bangladeshi and Mixed white and Asian, but excluded 'other Asian background'. Each person in the screening pilot was linked by postcode to a Census Area Statistics ward. People were grouped according to the quintile of the percentage of the population of Indian subcontinent origin for their ward. The highest quintile, with wards of 10% or more of their population of Indian subcontinent origin, was compared with the lower four quintiles.

The main outcome measures and factors included in the analyses are given in table 1. The uptake rate of screening was the number of people who returned an adequate kit over the number of people who were invited. For a small number of kits (n=169, 89 and 103 in rounds 1, 2 and 3, respectively), it was not possible to carry out the test, in which case, a further kit was sent out, which may not have been returned. The number of people who were invited to screening was used rather than the number of people who may have been eligible. People may not have been invited for a variety of reasons, mainly ill-health. The uptake of colonoscopy used the number of people with a positive FOBt outcome as the denominator and the number of people attending colonoscopy as the numerator.

Analyses were conducted using simple tabulations and logistic regression to compare the main outcome measures between the three rounds. Results for the logistic regression are given as ORs with 95% CIs. Multivariate analyses, which included all demographic factors, produced ORs of estimated effects adjusted for all other factors. Deprivation and ethnicity were not studied in relation to detection rates or sensitivity, however, because of the small numbers of cancers/neoplasia in some categories. Interaction terms have been included between some factors and screening round, where effects were indicated in simple tabulations. Sensitivity was calculated using the proportional incidence method, in which the observed rate of interval cancers is compared with the expected incidence in the absence of screening.[9] Expected rates were estimated using population figures for England and for West Midlands.

In addition, results were compared with those from the randomised controlled trial of screening by FOBt that was conducted in the Nottingham area between 1981 and 1991. In that trial, over 150 000 people were allocated equally between an intervention and control arm, and those in the intervention arm were offered two-yearly screening by FOBt.[10] Data from this trial are held and analysed at the Cancer Screening Evaluation Unit. One of the evaluators (SM) is a co-investigator in this trial, and we obtained permission from the principal investigator at Nottingham to use these data for comparison purposes in this evaluation. To compare results between the third rounds of the pilot and the Nottingham trial, we restricted the study populations to people who had been screened in two previous rounds and were aged 60–69 years in the third round.

Table 1 Outcome measures and related factors

Outcome measures	Uptake rate of screening
	Uptake rate of colonoscopy
	Positivity of the screening test
	Detection rate of neoplasia (adenomas or bowel cancers)
	Detection rate of bowel cancer
	Sensitivity
	Positive predictive value (PPV) for neoplasia
	PPV for bowel cancer
Factors	Age, gender, social deprivation, ethnicity and screening history
	For analysis of the second and third rounds, the categories of screening history were defined by participation in previous rounds: ► invitation, to previous non-responder ► invitation at <2.5 years interval after previous screen ► invitation at ≥2.5 years interval after previous screen (third round only): responded in first round but not in second round

RESULTS

Uptake

The total crude uptake rate was 61.8%, 57.0% and 58.7% in the first, second and third rounds, respectively (table 2). There was a significant decrease in the second round followed by a significant increase in the third round ($p<0.001$), although uptake remained lower than in the first round. The uptake was consistently higher in women than men, but there was a significant interaction between round and gender such that the gender gap narrowed over time. Other variables showed a consistent relation to uptake across rounds, with uptake increasing with age (table 2) and being lower in people living in the more deprived areas and in areas with a high proportion of people from the Indian subcontinent (table 2). There was also a significant interaction between the latter two factors, the effect of deprivation being greater in areas with a high percentage of Indian subcontinent population. In the third round, uptake ranged from 36% (442/1220) in younger men in areas of high deprivation and percentage of Indian subcontinent population to 70% (2767/3977) in older women in the most affluent areas with a relatively low percentage of Indian subcontinent population. In regression analyses, all factors remained significantly related to uptake. Uptake was also strongly related to screening history, being lowest in those who had not taken up screening in previous rounds, and highest in those who had been screened in the previous round—that is at <2.5 years interval (table 2).

Table 2 Uptake by round in 60–69-year-olds given as percentages with the denominator (n)

	1st round, % (n)	2nd round, % (n)	3rd round, % (n)
Total	61.8 (49 311)	57.0 (48 633)	58.7 (49 664)
Men	57.7 (24 746)	53.4 (24 077)	55.8 (24 693)
Women	65.9 (24 565)	60.5 (24 556)	61.6 (24 971)
Age group			
60–64 years	61.0 (27 439)	55.6 (27 239)	57.9 (28 449)
65–69 years	62.8 (21 872)	58.8 (21 394)	59.8 (21 215)
Social deprivation			
1–2	70.2 (17 476)	65.3 (17 809)	66.7 (18 588)
3–4	61.6 (22 873)	55.8 (22 594)	57.8 (23 054)
5*	45.8 (8 888)	42.0 (8 147)	42.6 (7 875)
% Indian Sub-continent origin			
1–4	64.5 (40 601)	59.3 (40 457)	61.1 (41 693)
5†	49.3 (8 636)	45.5 (8 093)	46.1 (7 824)
Screening history			
Invitation, previous non-responder	–	13.5 (17 997)	10.2 (16 006)
Invitation at <2.5 years interval	–	82.6 (30 636)	88.7 (28 281)
Invitation at ≥2.5 years interval	–	–	45.2 (5 377)

*People in most deprived areas.
†Highest % of people from Indian subcontinent.

Positivity

The positive rate was significantly lower in the third round (p<0.001) than each of the other rounds (2.1%, 2.2% and 1.6% in the first, second and third rounds, respectively, table 3). In each round, the positive rate was significantly higher in men than women (OR for all three rounds combined 0.63, 95% CI 0.49 to 0.68), in more deprived than more affluent areas (p<0.001), and in people living in areas with a high percentage from the Indian subcontinent than in those from areas with a low percentage (table 3). In multivariate regression analyses, the positive rate was significantly related to all variables.

In both the second and third rounds, the positive rate was highest in those who had not previously accepted screening and lowest in people who had responded to screening in the previous round (in the third round, the rates were 2.9% and 1.5%, respectively (table 3)).

Colonoscopy

The uptake of colonoscopy differed significantly across rounds (p<0.05), being lowest in the first round (78.7%, 512/651) and highest in the third round (84.3%, 391/464). However, these results should be interpreted with caution, as it was noted in the first round report[4] that the uptake rates may have been underestimated because of problems with recording of data. Uptake of colonoscopy did not vary significantly by age or gender. In the third round, the uptake was only 76% (59/78) in the most deprived areas compared with 86% (330/385) in the other areas (p=0.02) (OR 1.96, 95% CI 1.09 to 3.56). In regression analyses, the colonoscopy uptake rate was significantly higher in the third round than the first, but other factors were not significant.

Neoplasia detection rates

The cancer and neoplasia detection rates were highest in the first round and decreased by the third round to 1.0 and 5.9 per 1000, respectively (table 4). Both rates decreased significantly across rounds (p<0.001). Within each round, the detection rates for cancer and for neoplasia were significantly higher in men than women (p<0.05 and p<0.001 for cancer (OR 0.42, 95% CI 0.19 to 0.93) and neoplasia (OR 0.40, 95% CI 0.28 to 0.55), respectively, in the third round).

In the first round, the overall detection rates of adenomas were 1.8, 3.5, 0.8 and 0.7 per 1000 for low, intermediate, high and unknown risk levels, respectively (table 5). In the third round, the values were 1.9, 1.7, 1.1 and 0.2 per 1000, respectively. Low to intermediate risk adenomas were the most common category in men and women in each round.

Stage of diagnosis

The proportion of cancers that were Dukes' stage A had decreased slightly by the third round, although the numbers

Table 3 Positive rate by round in 60–69-year-olds given as percentages with the denominator (n)

	1st round, % (n)	2nd round, % (n)	3rd round, % (n)
Total	2.14 (30 480)	2.19 (27 718)	1.59 (29 161)
Men	2.74 (14 286)	2.65 (12 867)	1.94 (13 781)
Women	1.60 (16 194)	1.80 (14 851)	1.28 (15380)
Age group			
60–64 years	2.08 (16 740)	2.13 (15 138)	1.50 (16 466)
65–69 years	2.21 (13 740)	2.27 (12 580)	1.71 (12 695)
Social deprivation			
1–2	1.62 (12 272)	1.63 (11 628)	1.21 (12 392)
3–4	2.36 (14 092)	2.35 (12 613)	1.76 (13 331)
5*	2.92 (4 072)	3.51 (3 423)	2.33 (3 354)
% Indian subcontinent origin			
1–4	2.02 (26 180)	1.97 (23 984)	1.50 (25 469)
5†	2.89 (4 256)	3.59 (3 680)	2.25 (3 608)
Screening history			
Invitation, previous non-responder	–	3.01 (2 423)	2.93 (1 638)
Invitation at <2.5 years interval	–	2.12 (25 295)	1.45 (25 093)
Invitation at ≥2.5 years interval	–	–	2.10 (2 430)

*People in most deprived areas.
†Highest % of people from Indian subcontinent.

Table 4 Bowel cancer and neoplasia detection rates and positive predictive values (PPVs) by gender and round (all invitations) in 60–69-year-olds

	1st round, (n)	2nd round, (n)	3rd round, (n)
Cancer detection rate per 10^3 (number screened)			
Total	2.3 (30 480)	1.6 (27 718)	1.0 (29 161)
Men	3.3 (14 286)	2.6 (12 867)	1.5 (13 781)
Women	1.5 (16 194)	0.8 (14 851)	0.6 (15 380)
PPV cancer (%)			
Total	10.90 (651)	7.4 (608)	6.5 (464)
Men	12.00 (392)	9.7 (341)	7.9 (267)
Women	9.27 (259)	4.5 (267)	4.6 (197)
Neoplasia detection rate per 10^3 (number screened)			
Total	9.1 (30 480)	8.3 (27 718)	5.9 (29 161)
Men	13.4 (14 286)	11.4 (12 867)	8.9 (13 781)
Women	5.2 (16 194)	5.5 (14 851)	3.2 (15 380)
PPV neoplasia (%)			
Total	42.6 (651)	37.7 (608)	36.9 (464)
Men	49.0 (392)	43.1 (341)	45.7 (267)
Women	32.8 (259)	30.7 (267)	24.9 (197)

Table 5 Detection rates (per 10^3) of adenomas of different risk

	1st round		2nd round		3rd round	
	Rate	No	Rate	No	Rate	No
Total	6.7	203	6.6	184	4.8	141
Men	10.1	143	8.9	114	7.3	101
Women	3.7	60	4.7	70	2.6	40
Low risk						
Total	1.8	56	2.6	71	1.9	54
Men	2.9	42	3.4	44	2.7	37
Women	0.9	14	1.8	27	1.1	17
Intermediate risk						
Total	3.5	107	2.8	77	1.7	50
Men	5.0	71	3.5	45	2.3	32
Women	2.2	36	2.2	32	1.2	18
High risk						
Total	0.8	23	1.0	27	1.1	31
Men	1.3	19	1.4	18	2.0	27
Women	0.2	4	0.6	9	0.3	4
Not known						
Total	0.7	20	0.3	9	0.2	6
Men	0.9	13	0.5	7	0.4	5
Women	0.4	7	0.1	2	0.1	1
No screened						
Total	–	30 480	–	27 718	–	29 161
Men	–	14 286	–	12 867	–	13 781
Women	–	16 194	–	14 851	–	15 380

Table 6 Test sensitivity by person-years of observation within the 2-year period after the first and second rounds

	After the 1st round		After the 2nd round	
	Men	Women	Men	Women
Person-years	27 543	31 692	24 364	28 445
Observed interval cancers	17	21	21	17
Per 1000	0.617	0.663	0.862	0.598
% of expected incidence detected by screening				
England-based population	70.7	49.6	64.9	50.8
West Midlands-based population	76.1	53.0	71.0	54.7

were too small to conduct further analyses. In the first round, 47.1% (32/68 including 10 polyp cancers) were Dukes' stage A (three cancers had stage not known), in the second round 31.1% (14/45 including eight polyp cancers), and in the third round 23.4% (7/30 including five polyp cancers) (difference between first and third rounds significant, p=0.04).

Positive predictive value (PPV)

In the third round, the PPVs of a positive test for cancer and neoplasia were 6.5% and 36.9%, respectively (table 4). The PPV for cancer was significantly lower in the third round than the first round (p<0.05) (OR 0.56, 95% CI 0.36 to 0.88), but the PPV for neoplasia did not vary significantly by round. The PPVs in men were almost double the values in women: 7.9% and 4.6%, respectively, for cancer (difference not significant) and 45.7% and 24.9%, respectively, for neoplasia (p<0.001) (OR 0.49, 95% CI 0.41 to 0.61). There was no relation to deprivation or ethnicity.

Interval cancers

The sensitivity was 71% and 50% in men and women, respectively, at the first round, and 65% and 51%, respectively, at the second round (table 6), the difference between the sexes being significant at the first round (p<0.05). There were no significant differences in sensitivity between values at the first and second rounds. Estimates of sensitivity differ slightly according to whether they are based on the population for England or the population for West Midlands.

Comparisons with Nottingham randomised controlled trial

Results were compared between the study populations in the pilot and in the Nottingham trial when both were restricted to the third round and people who responded in the first and second rounds. A further analysis was restricted to those whose test was negative in the first and second rounds (table 7). The uptake rate was similar in both studies, but the positive rate was higher in the pilot than the Nottingham trial. The cancer and neoplasia detection rates were very similar to the Nottingham trial results. The PPVs for cancer and neoplasia in the pilot were noticeably lower than those in the Nottingham trial.

Screening in the over 70s

People aged over 70 years were not invited routinely for screening in the second or third rounds but they were able to request a kit from the screening centre if they wished. In the second round, 348 people aged between 70 and 89 years requested a kit, of whom 323 (93%) returned an adequate kit. In the third round, the corresponding figures were 254 and 231 (91%), respectively. More men than women requested a kit in the third round and completed it: 145 men and 86 women. In the third round, 82 were new self-invitees with no record of a previous screening invitation. The numbers were too small to analyse other outcomes.

DISCUSSION

In contrast with the Scottish pilot site, the fall off in uptake in the second round was not as substantial, and uptake rallied in the third round. The narrowing of the gender gap over the course of the pilot is an interesting finding and suggests that over time the concept of screening may become more acceptable among a male population. The effect of deprivation and ethnicity was more resilient and underlines the need to find new and novel approaches to improving uptake in hard-to-reach groups. Importantly, in common with the Scottish pilot site,[11] uptake of colonoscopy is also affected by deprivation, underlining the need for focused efforts in this group.

The effect of previous screening history is consistent with that observed in other screening programmes and suggests there is a group in the population who will remain resistant to screening over time; despite this, repeat invitations to those who decline FOBt screening can produce worthwhile increases in uptake.[12] Similar categories will be reported from the national programme, and it will be possible to study whether these patterns continue to be observed. Although in the third round, people with a negative colonoscopy after a positive FOBt in the second round were re-invited, the numbers were too small to examine the effect on uptake.

The fall off in cancer and neoplasia detection rates follows similar patterns to other screening programmes; in the early stages of the programme, there will be a significant proportion of prevalent cancers, but, as the programme progresses, the proportion of incident cancers will increase. Length bias will have influenced the difference in percentage distribution of cancers by stage between rounds. Importantly, the predictive value of a positive FOBt remained fairly consistent across the

Table 7 Comparison of screening outcome measures in the third round of the pilot with those in the Nottingham trial

	Population	Uptake (%)	Positive outcome (%)	Cancer detection rate per 1000	Neoplasia detection rate per 1000	PPV cancer (%)	PPV neoplasia (%)
Third round (restricted to people who responded in the first and second rounds)							
Pilot	25 728	90.6	1.41	0.94	5.15	6.69	36.47
Nottingham	11 892	91.6	1.04	1.10	4.50	10.62	43.36
Third round (restricted to people whose test was negative in the first and second rounds)							
Pilot	25 030	91.7	1.26	0.96	4.88	7.61	38.75
Nottingham	11 798	91.7	0.95	1.11	4.25	11.65	44.66

PPV, positive predictive value.

three rounds. PPV is an important marker of screening programme performance, and a low PPV is associated with high rates of unnecessary investigations and treatments for false positive results. The sensitivity of the screening test was higher in men than women after both the first and second rounds. A similar observation has been made in the Finnish bowel cancer screening programme.[13] It will be important to monitor these differences in the NBCSP in the UK.

The analyses in this paper were limited by the data available from the pilot; we did not have access to patient-level identifiable data. In particular, it was only possible to examine the effect of ethnicity on outcome measures indirectly, based on the percentage of the population of a given ethnic origin in an individual's census ward (determined by postcode). We recognise the limitations of this approach; it does not sufficiently differentiate between ethnic minority populations, and depends on individuals within ethnic groups responding to screening in a consistent way. Detailed examination of patterns of bowel and breast screening attendance using name recognition software has been described by others,[14 15] and similar associations between uptake and ethnicity described.

We noted a reduced proportion of Dukes A cancers after the first round of screening. The lower proportion of early stage cancers detected at incident screens than at prevalent screens has been observed elsewhere,[10 12] and may be due to length bias and/or the detection of cancers at incident screens missed at earlier rounds.

The uptake of colonoscopy may be underestimated in our analyses due to lack of incomplete information on reasons for non-referral or attendance in those with a positive FOBt.

The bowel cancer screening programme in England is gaining momentum, and roll out is almost compete; there will soon be an extension of the age range beyond the current 60–69-year age group. Other developments will take place in colorectal screening in the near future; there is interest in newer immunochemical tests, which hold the prospect of greater accuracy and ease of completion.[16–20] Further evidence is beginning to emerge on the effectiveness of flexible sigmoidoscopy screening[21]; combined use of FOBt and flexible sigmoidoscopy in a screening programme needs careful analysis.

Results of this analysis of three rounds of data suggest that substantial ongoing efforts will be required to avoid significant disparities in uptake between deprived and wealthy populations and between ethnic and non-ethnic minorities. There is already evidence of inequalities in access to treatments for bowel cancer, with associated differences in survival[22]; disparities in screening uptake could compound these inequalities. Evidence is also emerging that suggests that, despite promising data on downstaging of cancers detected,[23] these inequalities are present in the early stages of the national programme.[24] The needs of ethnic subgroups require careful analysis in screening programme implementation; for example, while the incidence of bowel cancer is lower among British south Asians, it is increasing, and there are differences in patterns of presentation.[25]

It is vital that screening programmes adequately address both overall uptake and disparities in uptake if they are to achieve their targeted public health benefits.[26] There are a great many structural, behavioural, cultural and health system-related influences on uptake of bowel cancer screening.[27] The role of primary care is attracting significant interest; while there are generally favourable attitudes towards FOBt screening among primary care providers and patients,[28 29] there is significant unrealised potential in primary care to increase both uptake and informed choice.

We found very low opt-in rates for people over the age of 70; this was not surprising, as there were minimal efforts to raise awareness of the programme in this age group. Since our study, the NBCSP in England has raised the upper age limit for formal invitations to screening from 69 to 75 years. Although benefits of screening typically decline as age increases, it is important to recognise that the specific health needs, choices and priorities of older and middle-aged people differ; screening programmes need to incorporate these differences into their structure and planning.[30]

The results also suggest that key parameters such as pathology detection rates and PPV can conform to acceptable parameters provided that due attention is paid to continuous quality assurance within the programme.

The results presented here, together with parallel data from Scotland,[2] demonstrate the challenges of delivering bowel cancer screening. Even in the context of a centralised population-level screening programme, there are significant challenges in ensuring equitable uptake across diverse socioeconomic and ethnic groups. These challenges in the delivery of colorectal cancer screening are seen in other healthcare contexts[31 32]; the importance of optimising organisational factors in the process of screening, as well as addressing the many behavioural and cultural factors that mediate uptake has been widely recognised.[33 34]

In conclusion, the Bowel Cancer Screening Programme is now well established in England. Performance measures such as pathology detected and predictive value are commensurate with expectations in a screening programme reaching its third round of screening. Achieving acceptable levels of uptake will require substantial ongoing effort; in particular, the effects of deprivation and ethnicity need to be addressed. Screening hubs, primary care trusts and other agencies involved in the delivery of bowel cancer screening will need to maintain efforts to promote equitable uptake of screening and to ensure that the current quality standards are maintained.

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Editor's quiz: GI snapshot

ANSWER

From the question on page 42

Dyssynergic defecation with resultant splenic flexure syndrome—The splenic flexure syndrome has been historically used to describe upper abdominal pain and bloating thought to be caused by abnormal gas propulsion leading to localised 'trapping' of intestinal gas at the splenic flexure region of the colon. It has long been considered a variant of irritable bowel syndrome.[1 2] Anatomic factors are believed to predispose to this syndrome. The splenic flexure occupies a position high under the diaphragm and is fixed by a peritoneal fold resulting in sharp angulation from a sagging transverse colon and the weight of a stool-filled descending colon.[3] Gas accumulates in this segment, provoking abdominal pain and bloating. More recently, it has been recognised that patients with gas retention and abdominal discomfort may have impaired fecal evacuation. Normally, evacuation of gas results from increased intra-abdominal pressure coupled with anal relaxation.[4] Incoordination of this process (dyssynergic defecation) produces functional outlet obstruction with fecal and gas retention. Consequently, there is also increased gas production from prolonged colonic fermentation of retained feces.[1] Thus, increased production and retention of gas from dyssynergic defecation may predispose to splenic flexure syndrome. Our patient's symptoms resolved with pelvic floor retraining through biofeedback treatment.

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