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Evaluation of a service intervention to improve awareness and uptake of bowel cancer screening in ethnically-diverse areas

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Background: Uptake of bowel cancer screening is lowest in London, in populations of lower socio-economic status, and in particular ethnic or religious groups.

Methods: We report on the evaluation of two interventions to improve uptake in an area including populations of low socio-economic status and considerable ethnic diversity. The interventions were face-to-face health promotion on bowel cancer screening at invitees' general practice and health promotion delivered by telephone only. Nine large general practices in East London were chosen at random to offer face-to-face health promotion, and nine other large practices to offer telephone health promotion, with 24 practices of similar size as comparators. Data at practice level were analysed by Mann–Whitney–Wilcoxon tests and grouped-logistic regression.

Results: There were 2034 invitees in the telephone intervention practices, 1852 in the face-to-face intervention practices and 5227 in the comparison practices. Median gFOBT kit uptake in the target population (aged 59–70) was 46.7% in the telephone practices, 43.8% in the face-to-face practices and 39.1% in the comparison practices. Significant improvements in the odds of uptake were observed following telephone intervention in both males (OR = 1.39, 95% CI = 1.20–1.61, $P < 0.001$) and females (OR = 1.49, 95% CI = 1.29–1.73, $P < 0.001$), while the face-to-face intervention mainly impacted uptake in males (OR = 1.23, 95% CI = 1.10–1.36), $P < 0.001$) but did not lead to a significant increase in females (OR = 1.12, 95% CI = 0.96–1.29, $P = 0.2$).

Conclusions: Personally delivered health promotion improved uptake of bowel cancer screening in areas of low socio-economic status and high ethnic diversity. The intervention by telephone appears to be the most effective method.

Colorectal cancer is the fourth most common cancer in the UK and the second most common cause of cancer death after lung cancer; in 2010, 40 695 new cases of colorectal cancer and 15 708 deaths

were recorded (Cancer Research UK, 2013). Increasing age is a risk factor with incidence rising as the population ages. The disease progresses slowly; a benign growth (polyp) becomes cancerous

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over a period of up to 10 years. Despite slow development of the disease, 25% of patients first present as emergencies after experiencing mild symptoms for weeks or months. More than half of patients are not diagnosed until the disease has spread to lymph nodes or elsewhere and late diagnosis is a key factor in poor survival from the disease. Fewer than 50% of patients with lymph node involvement and only 7% of patients with metastatic spread are still alive 5 years after diagnosis compared with 93% of patients with early disease (Dukes Stage A) (National Cancer Intelligence Network, 2013).

Bowel cancer screening aims both to prevent colorectal cancer occurrence by identifying and removing polyps, and to increase survival by diagnosing bowel cancer early, ideally at a pre-symptomatic stage. The English NHS Bowel Cancer Screening Programme (NHS BCSP) offers guaiac faecal occult blood testing (gFOBt) every 2 years for men and women aged 60–69 (Morris *et al*, 2012a). Uptake of screening is defined as the percentage of invited subjects who return an adequately completed gFOBt kit within 26 weeks of their invitation (BCSS system). The national target for uptake in the NHS BCSP is 60%. In the prevalent round of the NHS BCSP, overall participation rates were shown to be 49.6% in men and 54.4% in women while uptake was lowest in the London hub (40%) and in the most deprived areas of London – 33% and 39% in the 4th and 5th index of multiple deprivation (IMD) quintiles, respectively (Logan *et al*, 2012). This is an example of ‘intervention-generated inequality’, the idea that ‘downstream’ preventive interventions can increase health inequalities by disproportionately benefiting more advantaged groups (Lorenz *et al*, 2013). The three inner north east London boroughs (and former Primary Care Trust areas) of City & Hackney, Newham and Tower Hamlets are characterised by high levels of deprivation and ethnic diversity (Office for National Statistics, 2001). Tower Hamlets and Newham have among the highest proportion of residents in England living in households where English is not spoken.

Survival rates from cancer (including colorectal cancer) in all three boroughs are lower than England averages and are likely to be linked to late diagnosis of cancer (Department of Health, 2011).

Recommendation by a trusted health professional such as a GP has been found to be significantly associated with increased gFOBt kit uptake within the national screening programme in the south of England (Hewitson *et al*, 2011). Recently, an intervention in Tower Hamlets involving the use of telephone calls by trained bi-lingual advocates calling on behalf of GPs to endorse screening contributed to significant increases in the uptake of breast screening and led to the introduction of a new service specification (Eilbert *et al*, 2009).

This project was set up to assess an intervention aimed at increasing awareness and uptake of bowel cancer screening among subjects in the London boroughs of City & Hackney, Newham and Tower Hamlets, to assist progress towards the national screening target of 60%. The methodology was based on a smaller pilot project run in 2011 (Massat *et al*, 2014) using targeted GP endorsement through letters, and health promotion provided by health advocates in the invitee’s first language over the telephone, or during group sessions. Here, we report on the results obtained for the different targeted age groups.

MATERIALS AND METHODS

Target population. The intervention planned to target up to 5000 subjects invited to participate in bowel cancer screening between January and December 2012. Delays in obtaining practice agreements and ITT lists meant that analysis only covers the period from April to December 2012, with 3886 subjects rather

than 5000. The intervention took place from April to December 2012 and was targeted at the following groups of subjects registered with the GP practices included in the intervention:

- Target group 1: subjects approaching the age of 60 years who were due to be invited to participate in the bowel cancer screening for the first time;
- Target group 2: subjects aged 61 to 69 due for second and subsequent invitations (recall) whose records showed that they had not responded to their last gFOBt invitation.

The intervention aimed to exclude subjects whose records showed that they had a diagnosis of colorectal cancer, palliative care needs or had opted out of the programme.

Recruitment and participants. Six GP practices in each of the three boroughs were selected as follows. Lists of all GP practices in City & Hackney, Newham and Tower Hamlets were compiled in decreasing order of practice population size. Three sets of randomised numbers were generated and applied to the GP lists, with the aim of recruiting six practices in each borough. Practices identified were contacted in the order of numbers generated and offered the opportunity to participate in the project. If a practice declined, the practice which had been assigned to the following number was approached until six practices in each borough had been recruited. In each borough, three of the practices that had agreed to participate were randomly assigned to offer HP over the telephone (Intervention A) and three practices to offer HP during monthly face-to-face sessions held at the GP practice (Intervention B). Practices that were not selected at random for the intervention or chose not to participate continued to be offered the usual level of service from the NHS BCSP and from ongoing local screening and health promotion services.

As the intervention practices were chosen randomly from the larger practices in the lists, we similarly took as comparison practices the remaining practices from within the three boroughs which were also above the median size of the practices ($N=24$, 5 in City & Hackney, 10 in Newham and 9 in Tower Hamlets).

Intervention. A community organisation with experience of telephone outreach to increase uptake of cancer screening in East London was commissioned to deliver the intervention on behalf of the 18 intervention practices. Trained bi-lingual advocates worked from GP premises with practice staff to carry out the intervention and provide monitoring data.

Information about all subjects aged 60–69 years, and due to be invited, was provided monthly by the NHS BCSP as ‘intention-to-treat’ (ITT) lists to each practice in the intervention set, in line with data sharing agreements in place. Practices were asked to review lists and to exclude subjects for whom GP endorsement to participate in bowel cancer screening would be considered inappropriate (patient had a diagnosis of colorectal cancer, needed palliative care or had opted out of the programme).

Intervention A (‘HP over the telephone’). The Community organisation sent a letter of endorsement on practice-headed paper, along with a localised version of the NHS BCSP leaflet to subjects in target groups, 2 weeks after their ‘screening due date’ (that is, as recorded on the ITT list). The letter gave brief information about the study and offered a telephone call to provide additional information about the screening test. Using telephone numbers recorded in GP registers, trained bi-lingual advocates telephoned subjects 1 week after sending letters, making up to three attempts to contact each person. Callers offered information about bowel cancer screening and answered subjects’ questions using a standardised script. Targeted subjects were offered the opportunity to opt out at any stage of the intervention.

Intervention B ('HP at face-to-face session'). A letter of endorsement and leaflet as above were sent to subjects in target groups. In this case, the letter also invited subjects to attend a group health information session at the GP practice premises. One week later, advocates telephoned subjects to remind them about the forthcoming session and answered their questions. Alternative session dates were provided if appropriate. On the day before each session, a reminder telephone call was made to those who had agreed to attend. Sessions were held monthly by trained advocates using a standardised format. Attendees were offered additional pictorial and multi-lingual guides to the test procedure and three pairs of disposable non-latex gloves. Targeted subjects were offered the opportunity to opt out at any stage of the intervention.

In both interventions, advocates were able to contact the NHS BCSP on behalf of the subjects invited to request replacement kits if these had not been received, had been discarded or had been spoiled. They also asked the subjects if they were willing to participate in a follow-up telephone interview 3 months after their screening invitation.

Uptake data. GP practice-level aggregate data on kit completion (number of invited and of gFOBt screened patients per practice) was provided by the NHS BCSP for the 18 intervention and 24 comparison practices in the three inner north east London boroughs for the second, third and fourth quarters of 2012 (April to December 2012). Results were requested for subjects aged 59–70 years, for the following populations:

- Population aged 59–60 years who received a first invitation: 'Invited prevalent 59–60';
- Population aged 61–70 years who received a second or subsequent invitation and who had never responded to ANY previous invitations: 'Invited prevalent 61–70';
- Population aged 61–70 years who received a second or subsequent invitation and who had responded to at least one previous invitation: 'Invited incident 61–70';
- Population aged 59–70 years who received a first or subsequent invitation (above groups combined): 'All invited 59–70'.

For each population group, data was available for males and females separately.

Statistical analysis. The uptake rate for each practice was calculated as the ratio of screened to invited patients (both males and females), and the median uptake for each borough was derived as a summary measure to avoid making any strong distributional assumption for the rates.

Difference in median uptake rates between intervention and comparison practices was assessed using non-parametric Mann–Whitney–Wilcoxon (MWW) testing with general practice as the unit of analysis. A grouped-logistic regression model (Hilbe and Robinson, 2013) was also fitted to the aggregate participation data obtained for the aforementioned populations. The effect of the intervention type (none, HP over the telephone, HP at face-to-face

session), gender and borough and any possible interactions were investigated. Interaction terms which were not significant, as assessed using a likelihood ratio test, were dropped from the model. Intervention by gender was kept in the final model as it was felt to be of potential interest and achieved significance at the 10% level for some of the groups investigated. The final model therefore included all main effects, a gender by intervention group interaction, and was also adjusted for practice population size. Results were presented on the odds ratio scale as they are independent of the level at which the covariate is held constant.

Sensitivity analyses were performed where the same analyses were repeated after excluding the 12 GP practices involved in the pilot study run during 2011 which targeted the population aged 60 at the time (Massat *et al.*, 2014). Three of the 12 GP practices which offered a similar HP intervention in the 2011 pilot study were included in the intervention set in the current project; four were included in the comparison set.

All statistical analyses were performed in R version 2.13.0 (The R Foundation for Statistical Computing, <http://www.r-project.org/foundation>).

RESULTS

Table 1 shows an overview of the target population, that is, all subjects invited to participate in bowel cancer screening during the second to fourth quarter of 2012 ('All invited 59–70'). A total of 3886 subjects (49.3% male, 50.7% female) aged between 59 years and 6 months and 70 years were sent a GP-endorsed letter offering them HP prior to their completion of the bowel cancer screening test kit. Of the 3886 subjects, 2034 subjects (51.4% male, 48.6% female) were offered HP over the telephone, and 1852 subjects (47.0% male, 53% female) were offered HP during a group face-to-face session; 2442 subjects (46.7% male, 53.4% female) of the same age, who did not receive any intervention, were identified in the comparison practices in the three boroughs.

'Invited prevalent 59–60'. Subjects aged between 59 and 60 years who were invited to the bowel cancer screening programme for the first time were included in the intervention (Target group 1). Table 2 shows the overall participation in bowel cancer screening among the 'Invited prevalent 59–60' population group. A total of 913 subjects aged between 59 and 60 years were sent the GP endorsement letter: 497 subjects were offered HP over the telephone, and 416 were offered HP during a face-to-face session. About 1219 subjects of the same age, who did not receive either intervention, were identified in the comparison practices. The overall median uptake from April to December 2012 was significantly higher in both the practices which offered HP over the telephone (45.7%, MWW $P=0.001$) and in those which offered HP at a face-to-face session (41.2%, MWW $P=0.02$) compared with the non-intervention practices (34.0%, Table 2). The median uptake was consistently higher in the intervention

Table 1. Target population: 'All invited 59–70' (April to December 2012)

Borough	Comparison general practices				Intervention general practices—telephone				Intervention general practices—session			
	No. of practices	Males (%)	Females (%)	Total	No. of practices	Males (%)	Females (%)	Total	No. of practices	Males (%)	Females (%)	Total
City & Hackney	5	624 (46.7)	713 (53.3)	1337	3	285 (48.0)	309 (52.0)	594	3	295 (49.0)	307 (51.0)	602
Newham	10	962 (47.0)	1087 (53.0)	2049	3	406 (52.3)	370 (47.7)	776	3	306 (44.7)	379 (55.3)	685
Tower Hamlets	9	856 (46.5)	985 (53.5)	1841	3	355 (53.5)	309 (46.5)	664	3	269 (47.6)	296 (52.4)	565
Total	24	2442 (46.7)	2785 (53.4)	5227	9	1046 (51.4)	988 (48.6)	2034	9	870 (47.0)	982 (53.0)	1852

Table 2. Overall participation in bowel cancer screening population groups (April to December 2012)

Borough	Comparison general practices		Intervention general practices—telephone		Intervention general practices—session	
	Participation number (screened)/total number (invited) overall practices (%) ^a	General practice median % uptake (IQR)	Participation number (screened)/total number (invited) overall practices (%) ^a	General practice median % uptake (IQR)	Participation number (screened)/total number (invited) overall practices (%) ^a	General practice median % uptake (IQR)
'Invited prevalent 59–60'						
City & Hackney	116/334	36.0 (8.3)	74/155	47.6 (12.1)	61/139	43.2 (2.2)
Newham	158/463	34.3 (11.0)	90/188	46.8 (2.6)	60/155	39.7 (4.9)
Tower Hamlets	138/422	33.3 (13.6)	64/154	41.5 (3.5)	50/122	41.2 (15.6)
Total	412/1219 (33.8)	34.0 (11.7)	228/497 (45.9)	45.7 (6.1)	171/416 (41.1)	41.2 (3.6)
'Invited prevalent 61–70'						
City & Hackney	68/532	11.6 (2.3)	43/227	16.7 (2.7)	60/259	19.7 (8.8)
Newham	115/914	13.5 (6.2)	67/303	22.0 (2.9)	81/339	24.8 (2.8)
Tower Hamlets	113/870	13.7 (2.6)	55/296	19.6 (2.5)	62/288	23.9 (4.0)
Total	296/2316 (12.8)	13.0 (4.4)	165/826 (20.0)	19.6 (5.4)	203/886 (22.9)	23.9 (6.1)
'Invited prevalent 59–70'						
City & Hackney	184/866	21.8 (2.0)	117/382	28.1 (5.5)	121/398	28.9 (5.7)
Newham	273/1377	19.2 (3.6)	157/491	33.0 (4.7)	141/494	27.5 (2.4)
Tower Hamlets	251/1292	19.8 (3.7)	119/450	27.1 (3.2)	112/410	25.8 (3.1)
Total	708/3535 (20.0)	20.0 (4.5)	393/1323 (29.7)	28.1 (6.2)	374/1302 (28.7)	27.5 (4.9)
'Invited incident 61–70'						
City & Hackney	376/471	81.8 (6.0)	176/212	82.4 (4.2)	167/204	83.1 (2.4)
Newham	535/669	78.1 (4.5)	231/284	81.5 (0.6)	154/191	79.2 (2.8)
Tower Hamlets	425/546	78.0 (5.2)	173/214	83.1 (4.8)	124/150	70.5 (14.6)
Total	1326/1686 (78.6)	78.3 (5.9)	580/710 (81.7)	81.8 (2.4)	445/545 (81.7)	79.2 (4.8)
'All invited 59–70' (target population)						
City & Hackney	560/1337	41.0 (7.0)	294/594	48.9 (6.3)	289/602	49.6 (2.9)
Newham	810/2049	38.4 (6.9)	388/776	50.3 (2.9)	295/685	42.6 (0.8)
Tower Hamlets	677/1841	36.5 (3.1)	292/664	45.3 (3.4)	237/565	41.7 (10.1)
Total	2047/5227 (39.2)	39.1 (5.5)	974/2034 (47.9)	46.7 (5.0)	821/1852 (44.3)	43.8 (4.7)

Abbreviation: IQR = interquartile Range.

^aMean percentage uptake overall practices.

practices for each of the three boroughs. Compared with no intervention, HP over the telephone increased the odds of uptake in females by 75% (OR = 1.75, 95% CI = 1.29–2.38, $P < 0.001$) and by about 60% in males (OR = 1.61, 95% CI = 1.19–2.17, $P = 0.002$, Table 3), while HP at face-to-face session increased the odds of uptake by about 35% in both males and females although this effect was not significant at the 5% level (Table 3). Being a male overall reduced the chance of responding to a first invitation by around 25% (OR = 0.75, 95% CI = 0.59–0.96, $P = 0.02$) but did not impact on the effect of the interventions (non-significant interaction terms, data not shown). The odds of uptake did not significantly differ between the three boroughs (Table 3).

'Invited prevalent 61–70'. Subjects aged between 61 and 70 years who had not responded to any of their previous invitations were also included in the intervention (Target group 2). Table 2 shows the overall participation in bowel cancer screening among the 'Invited prevalent 61–70' population group. A total of 1772 subjects were sent a GP endorsement letter: 826 subjects were offered HP over the telephone and 886 subjects were offered HP during a

face-to-face session. About 2316 subjects of the same age, who did not receive either intervention, were identified in the comparison practices. The overall median uptake was significantly higher for both HP interventions (over the telephone: 19.6%, MWW $P < 0.001$ and face-to-face session: 23.9%, MWW $P < 0.001$) compared with no intervention (13.0%, Table 2). The odds ratio between the intervention and the comparison practices were found to be statistically significantly > 1 as shown in Table 3: both types of intervention increased the odds of uptake by at least 50% in males (OR = 1.59, 95% CI = 1.16–2.18, $P = 0.004$ for HP over the telephone, and OR = 2.28, 95% CI = 1.69–3.09, $P < 0.001$ for HP at face-to-face session, both $P < 0.001$) and females (OR = 1.78, 95% CI = 1.34–2.37, and OR = 1.78, 95% CI = 1.36–2.32, respectively, both $P < 0.001$, Table 3). As observed for the 'Invited prevalent 61–70' population, being a male overall reduced the chance of responding to a first invitation by around 25% (OR = 0.77, 95% CI = 0.60–0.99, $P = 0.04$), but did not impact on the effect of either intervention (non-significant interaction terms, data not shown). The odds of uptake did not significantly differ between boroughs (Table 3).

Table 3. Effect of health promotion intervention type on uptake at general practice level, by gender and London borough in the bowel cancer screening population groups (ITT analysis—April to December 2012)

		Blocked logistic regression output		
Explanatory variable	Category	OR	95% CI	Significance (^a)
'Invited prevalent 59–60'				
Borough effect	City & Hackney	1.00	–	–
	Newham	0.95	0.76–1.18	0.6 (0.4)
	Tower Hamlets	0.86	0.69–1.08	0.4 (0.07)
Gender effect	Female	1.00	–	–
	Male	0.75	0.59–0.96	0.02 (0.04)
Intervention effect in females ^b	No HP	1.00	–	–
	HP over the telephone	1.75	1.29–2.38	<0.001 (<0.001)
	HP at face-to-face session	1.37	0.99–1.87	0.06 (0.06)
Intervention effect in males ^b	No HP	1.00	–	–
	HP over the telephone ^c	1.61	1.19–2.17	0.002 (<0.001)
	HP at face-to-face session ^c	1.37	0.98–1.91	0.06 (0.1)
'Invited prevalent 61–70'				
Borough effect	City & Hackney	1.00	–	–
	Newham	1.06	0.85–1.31	0.6 (0.6)
	Tower Hamlets	1.01	0.81–1.27	0.9 (0.4)
Gender effect	Female	1.00	–	–
	Male	0.77	0.60–0.99	0.04 (0.01)
Intervention effect in females ^b	No HP	1.00	–	–
	HP over the telephone	1.78	1.34–2.37	<0.001 (<0.001)
	HP at face-to-face session	1.78	1.36–2.32	<0.001 (<0.001)
Intervention effect in males ^b	No HP	1.00	–	–
	HP over the telephone ^c	1.59	1.16–2.18	0.004 (0.002)
	HP at face-to-face session ^c	2.28	1.69–3.09	<0.001 (<0.001)
'Invited prevalent 59–70'				
Borough effect	City & Hackney	1.00	–	–
	Newham	0.95	0.82–1.11	0.5 (0.4)
	Tower Hamlets	0.87	0.75–1.02	0.08 (0.1)
Gender effect	Female	1.00	–	–
	Male	0.82	0.70–0.97	0.02 (0.07)
Intervention effect in females ^b	No HP	1.00	–	–
	HP over the telephone	1.82	1.49–2.23	<0.001 (<0.001)
	HP at face-to-face session	1.51	1.24–1.84	<0.001 (<0.001)
Intervention effect in males ^b	No HP	1.00	–	–
	HP over the telephone ^c	1.56	1.27–1.93	<0.001 (<0.001)
	HP at face-to-face session ^c	1.68	1.36–2.09	<0.001 (<0.001)
'Invited incident 61–70'				
Borough effect	City & Hackney	1.00	–	–
	Newham	0.98	0.78–1.22	0.8 (0.5)
	Tower Hamlets	0.92	0.73–1.16	0.5 (0.4)
Gender effect	Female	1.00	–	–
	Male	0.87	0.68–1.10	0.2 (0.2)
Intervention effect in females ^d	No HP	1.00	–	–
	HP over the telephone	1.12	0.82–1.54	0.5 (0.8)
	HP at face-to-face session	0.95	0.68–1.32	0.8 (0.4)
Intervention effect in males ^d	No HP	1.00	–	–
	HP over the telephone ^c	1.21	0.86–1.66	0.3 (0.2)
	HP at face-to-face session ^e	1.47	1.01–2.15	0.04 (0.2)
'All invited 59–70'				
Borough effect	City & Hackney	1.00	–	–
	Newham	0.91	0.82–1.01	0.09 (0.04)
	Tower Hamlets	0.80	0.72–0.89	<0.001 (<0.001)
Gender effect	Female	1.00	–	–
	Male	0.83	0.74–0.93	<0.001 (0.002)
Intervention effect in females ^b	No HP	1.00	–	–
	HP over the telephone	1.49	1.29–1.73	<0.001 (<0.001)
	HP at face-to-face session	1.12	0.96–1.29	0.2 (0.2)
Intervention effect in males ^b	No HP	1.00	–	–
	HP over the telephone ^c	1.39	1.20–1.61	<0.001 (<0.001)
	HP at face-to-face session ^e	1.36	1.16–1.60	<0.001 (0.006)

Abbreviations: CI = confidence interval; HP = health promotion; OR = odds ratio.

^aP-values shown after excluding the 12 practices which were included in the pilot (Massat et al, 2014)

^bOverall intervention effect (over the telephone + face-to-face session) was significant at the 5% level.

^cThe effect of intervention (over the telephone/face-to-face session) in males was not significantly different from the effect of intervention in females at the 10% level.

^dOverall intervention effect (over the telephone + face-to-face session) was not significant at the 5% level.

^eThe effect of intervention (over the telephone/face-to-face session) in males was significantly different from the effect of intervention in females at the 10% level.

'Invited prevalent 59–70'. The overall results for all those invited to complete the gFOBT kit for the first time are also presented in Table 3. They confirm that both interventions had a significant effect on uptake regardless of gender, borough or practice size, and there was no significant difference between these two types of intervention in this patient group (OR = 0.94, 95% CI = 0.79–1.11, $P = 0.5$, data not shown).

'Invited incident 61–70'. The intervention did not intend to target subjects in this group unless they had not responded to their most recent gFOBT invitation. During the latter months of the project, a change in the format of the ITT lists meant that information about previous participation was not available and subjects in the group were included in the intervention (see limitations below). Table 2 shows the overall participation in bowel cancer screening among the 'Invited incident 61–70' population group. A total of 1255 and 1686 subjects were re-invited for bowel cancer screening in the intervention practices and the comparison practices, respectively. Compared with the non-intervention practices (78.3%, Table 2), the overall median uptake was only just significantly higher in the practices which offered HP over the telephone (81.8%, MWW $P = 0.05$) but not in those which offered HP at a face-to-face session (79.2%, MWW $P = 0.5$). The odds of uptake did not significantly differ between intervention and comparison practices (Table 3), although the face-to-face HP intervention had a significant effect among men (OR = 1.47, 95% CI = 1.01–2.15, $P = 0.04$, Table 3) which differed from its effect among women in this patient group (significant interaction terms, data not shown). However, this result was not reproduced in the sensitivity analysis where the 12 practices which received intervention during the pilot study were excluded from the analysis dataset ($P = 0.2$, Table 3).

'All invited 59–70'. When the data from all males and females routinely invited for gFOBT screening during April to December 2012 was analysed (see Table 1 for details), the median uptake in each borough was still observed to be consistently higher in the intervention practices than in the comparison practices (Table 2, HP over the telephone 46.7%, MWW $P < 0.001$, HP at a face-to-face session 43.8%, MWW $P = 0.01$). The effect of the over the telephone HP intervention on the odds of uptake was still found to be highly significant for both females (OR = 1.49, 95% CI = 1.29–1.73, $P < 0.001$) and males (OR = 1.39, 95% CI = 1.20–1.61, $P < 0.001$, Table 3), whereas the effect of the face-to-face session HP intervention only remained significant among men (OR = 1.36, 95% CI = 1.16–1.60, $P < 0.001$, Table 3). As expected from the results obtained for individual patient groups, the odds of uptake were overall significantly lower, around 15% lower, in men compared with women in the absence of any intervention (OR = 0.83, 95% CI = 0.74–0.93, $P < 0.001$, Table 3). In addition, the odds of uptake were highest in City and Hackney (Table 3).

The results described above remained largely unchanged when the 12 GP practices which had been involved in the 2011 pilot phase of the study were excluded from the analysis (see Table 3 for details).

DISCUSSION

Bowel cancer screening participation has been observed to be lower in deprived groups and in certain ethnic groups, notably South Asian since the inception of the programme in the UK (Whynes *et al*, 2003; von Wagner *et al*, 2009; Moss *et al*, 2012; Mansouri *et al*, 2013).

Our results show that a population-level health promotion package delivered around the time of receipt of a patient's first gFOBT kit substantially and significantly improved uptake in an ethnically-diverse and relatively deprived population with low

awareness and participation. In the prevalent population group aged 59–60, uptake increased from 34 to 44%, whereas in the prevalent population group aged 61–70, uptake increased from 13 to 21.5% (both interventions included). In contrast, little change was observed in the incident population group; this was expected as the baseline uptake was already very high (78.3%).

The results suggest that offering health promotion over the telephone was overall the most effective intervention of the two approaches in providing information and in increasing uptake at population level (although the difference was not significantly different from the effect of offering face-to-face health promotion in group sessions, data not shown). Face-to-face health promotion sessions may have more impact on men in terms of making the decision to return the gFOBT kit. This could be the result of a direct interaction between this type of intervention and male-specific behaviours (Christy *et al*, 2014) or a consequence of the social behaviour of Pakistani and Bangladeshi women (Ahmed and Dale, 2008). Other authors only reported a positive association between attendance at a public information talk and uptake of colorectal screening among women of south east Asian ethnicity (Singaporean population, Wong *et al*, 2013).

The NHS BCSP aims to offer informed choice to eligible subjects. In areas of high ethnic diversity and socio-economic deprivation, where English language skills, health literacy and awareness of cancer screening programmes are lower than average, 'informed' choice is more difficult to achieve. This intervention aimed to reduce the inequalities in access to information by offering verbal information and discussion in the subjects' first language, while avoiding potential coercion. Trained bi-lingual advocates working with GP practices used standardised health promotion scripts, ensuring that subjects contacted could opt out of the intervention at any point and that they understood that they were not required to participate in bowel cancer screening. Records of telephone conversations and follow-up calls confirmed that some subjects made an informed choice not to participate in the screening.

The study was carried out in a real-life environment and a number of variables were outside the control of the researchers, making it difficult to adhere to the protocol throughout the project and leading to some degree of imprecision in the population groups studied. However, similar challenges might be expected if the intervention were to be repeated in comparable populations. A number of observations arose in relation to the delivery of the planned interventions.

(1) Currently, GPs do not have access to information about individuals who are due to be invited to participate in screening. Only individuals approaching the age of 60 and due for their first invitation can be identified through practice registers. A change in policy by the NHS BCSP enabling GPs to receive lists of invited people ahead of their screening invitation would be required for wider adoption of this intervention.

(2) During the 9 months of the intervention period, uptake data showed that 13.5% more subjects had been invited to participate in the NHS BCSP than appeared on the ITT lists sent to the intervention GP practices, suggesting that not all invited subjects received the intervention.

(3) Incorrect telephone numbers contributed to callers being unable to make contact with 48% of subjects in the HP over the telephone group and 45% in the HP face-to-face group. This meant that only just over half the target population received the full intervention. Related to this, some address data is likely to have been out of date so that some targeted people may have received neither the invitation nor the intervention. Routine updating of patient details on practice registrars could potentially increase the impact of the intervention.

(4) Part way through the project, reduced capacity in the NHS BCSP led to an extended delay in providing ITT lists. When these

resumed, the format had changed and information about previous invitations and opt-out status were omitted. Thus during the last 4 months of the project, the intervention may not have coincided with the gFOBT invitation, and was offered to all invited subjects, regardless of previous participation or opt-out status. In a wider programme, resources in the NHS BCSCP would need to be ensured to enable consistent information to be available to GPs.

(5) Finally, incomplete or inaccurate NHS BCSCP records meant that subjects with a diagnosis of colorectal cancer were not always identified from GP records, and callers needed to be aware that the intervention may have been applied inappropriately.

Improvements in any of these areas would likely lead to a more effective intervention.

There are other aspects of adherence in the screening 'journey' which would merit future research. Returning the gFOBT kit is the first stage in participation to the NHS BCSCP, full benefit being obtained when individuals who test positive progress to further investigation (usually colonoscopy). Uptake of colonoscopy has been shown to be lower in more deprived and in non-White populations (Morris *et al*, 2012b). An informal audit by the NHS BCSCP of people tested in 2012 indicates high rates of withdrawal from the programme before colonoscopy in inner NEL. A high proportion of these appear to be individuals with one or more normal results during previous screening episodes and who had attended for assessment at a specialist practitioner clinic. There is no information on subsequent pathways for this group. Further research is indicated into reasons for withdrawal from the programme (at various stages) by people identified at very high risk of bowel cancer through screening.

To comply with confidentiality regulations according to the service level agreements already in place, the study did not seek to track individual results. In addition, it was not possible to identify whether an individual who had received telephone or face-to-face health promotion had returned a completed gFOBT kit. Therefore, only aggregate practice-level data was analysed by comparing uptake rates for the practices chosen at random to receive the interventions with uptake rates in the comparison (non-intervention) practices. However, uptake rates are based on official number of gFOBT kits sent out from and returned to the bowel screening hubs. Thus, we analysed official data from the screening programme, with the consequent standards of data quality and accuracy.

Future analyses will investigate the effects of practice attributes, including size, training status and ethnic breakdown.

Delivery costs including staffing (bi-lingual advocates), training, information resources and disposable gloves, stationary, postage and telephone calls and follow-up interviews. The total budget was £50 000, equivalent to £10 per planned/ITT person targeted. If provided as part of routine primary care by GP practices, we estimate costs at £6 per head; management costs for an external commissioned organisation and follow-up interviews would not be required. These costs are consistent with those estimated for a similar intervention used as part of distributional cost-effectiveness analysis of the NHS BCSP: £7 per person targeted with an estimated increase in mean gFOBT uptake of 12% (Asaria *et al*, 2013). The analysis suggested that such a targeted screening strategy was cost effective and may contribute to a reduction in the health inequalities accompanying the implementation of a universal screening programme.

Endorsement of GP has been observed, both in the UK and elsewhere, to be effective in increasing FOBT uptake (Cole *et al*, 2002; Hewitson *et al*, 2011). Advance notification letter prior to the standard invitation-to-screen letter has also been shown to improve participation (Cole *et al*, 2007; Libby *et al*, 2011), while automated telephone calls providing a description of and health benefits of gFOBT have been found to significantly improve uptake rates in a US trial (Mosen *et al*, 2010). A trial is currently

evaluating the effectiveness of a GP-endorsed reminder in improving patient participation in the NHS BCSP in the West Midlands (Damery *et al*, 2012), while the efficacy of a patient decision aid (fridge magnet with telephone help line and website) distributed by community-based family physicians is being evaluated in a Canadian trial (Clouston *et al*, 2012). None of these interventions are focussed specifically on Asian or ethnically-diverse populations. To our knowledge, this study is the first to demonstrate experimentally that a telephone promotion improves participation. The findings suggest that telephone information and promotion may directly engage more subjects invited to participate in the NHS BCSP for the first time than offering face-to-face health promotion, may have a greater impact on increasing bowel cancer screening uptake and therefore in reducing health inequalities, and is likely to be more cost-effective.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

JS supervised the study and wrote parts of the manuscript. NJM performed the statistical analysis and wrote parts of the manuscript. LK was the project lead and wrote parts of the manuscript. SA, AG, SK, SR, ZC and WH contributed to study concept, study conduct and manuscript editing. DP carried out the data informatics. SWD provided general statistical guidance and wrote parts of the manuscript. All authors reviewed and approved the final manuscript.

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