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ORIGINAL ARTICLE

Direct mail from primary care and targeted recruitment strategies achieved a representative uptake of prostate cancer screening

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Abstract

Background and Objectives: Prostate cancer screening studies has previously not been able to reflect a diverse group of participants. We evaluated a range of recruitment strategies and their ability to recruit from the Black population and areas of deprivation.

Methods: IP1-PROSTAGRAM was a prospective, population-based, paired screening study of 408 participants conducted at seven UK primary care practices and two imaging centres. All participants underwent screening with a prostate specific antigen (PSA) test, magnetic resonance imaging (MRI), and transrectal ultrasound. A number of recruitment strategies were embedded including direct mail, media campaigns, and a targeted recruitment strategy to increase participation among harder-to-reach groups.

Results: A total of 1,316 expressions of interest were received (20th September 2018 to 15th May 2019). The direct mail strategy generated 317 expressions of interest from 1707 invitation letters. Overall 387 expressions of interest were received following the targeted strategy and 612 from media campaigns. The recruitment target was met 19 months ahead of the schedule. Of the 411 participants, ethnicity was White (38.0%), Black (32.4%), Asian (23.0%), and Other/Mixed (4.4%) ethnic groups. This higher recruitment of Black men was

The study received UK National Research Ethics Committee (8/LO/1338) and was conducted in accordance with Good Clinical Practice guidelines and the Declaration of Helsinki. All participants provided written informed consent. The trial was overseen by an Independent Trial Steering Committee and registered (ClinicalTrials.gov NCT03702439; ISRCTN43502108).

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driven by the targeted recruitment strategy. A comparison of recruitment methods showed marked differences between ethnicities recruited ($P < 0.001$). The proportion of Black participants recruited by direct mail (8%) was similar to the prevalence of Black local population (9%) whereas, targeted recruitment was 88% (115) and media recruitment 1.7% (1). The Index of Multiple Deprivation (IMD) distribution was similar to the local population with marginal higher recruitment from more deprived areas; proportion increasing from 26% to 40% from least to most deprived IMD quintiles (Quintiles 4/5 vs. 1/2). Direct mail recruited a close-to-normal distribution for deprivation with targeted recruitment trending towards recruiting from most deprived areas.

Conclusion: Direct mail and targeted strategies designed to engage a diverse population can achieve a representative uptake from Black participants and those from a lower socioeconomic group.

Keywords: Prostate cancer; Screening; MRI; Recruitment strategy; PSA; Socio-economic diversity

1. Introduction

A key issue of population-based screening studies is ensuring diverse uptake across different ethnicities and levels of socio-economic status. This is pertinent given that differences in prostate cancer incidence and mortality rates between men of African, Asian, and European ancestry and evidence [1−4] demonstrating higher prostate cancer risk in Black men.

The relationship between prostate cancer mortality and ethnicity has been complicated by the interaction with socioeconomic disparities. Socioeconomic status is a major determinant of mortality among other tumour types with established screening programmes such as colorectal, breast, and cervical cancer [5−7]. In prostate cancer, a similar relationship has been shown, driven by lack of access to and use of healthcare services among lower socioeconomic groups [8,9].

Previous prostate cancer screening trials have not been able to recruit a diverse study population with percentage of Black participants in the US Prostate Lung Colorectal Ovarian (PLCO) at 4% [10] and UK CAP at 2% [11]. The European randomised study for prostate cancer (ERSPC) study did not report ethnicity [12]. Furthermore, participants in PLCO [13] and CAP [14] were also of a higher socioeconomic status. We evaluated numerous recruitment strategies to ensure a diverse population with the IP1-PROSTAGRAM prostate cancer screening study. The aim was to evaluate the optimal recruitment method(s) to use in any future study of prostate cancer screening.

2. Methods

2.1. Study design

IP1-PROSTAGRAM was a prospectively registered, population-based, paired screen-positive cohort study which recruited men aged 50-69 years in the UK [15] (Fig. 1). In brief, participants received a prostate specific antigen (PSA), Prostagram magnetic resonance imaging (MRI) and transrectal ultrasound; we showed that Prostagram MRI was able to detect more clinically significant prostate cancers than PSA with a similar biopsy rate.

2.2. Recruitment strategy design

Advice was taken from groups working in lung cancer screening [16,17] who had designed campaigns to target lower socioeconomic groups for lung cancer screening. They had shown that excessive health related messaging in invitations triggers fearful responses with defensive and avoidant behaviour [18]. A further barrier faced by many screening tests, but especially in prostate cancer, is that a large proportion of our respondents were likely to be asymptomatic, creating less of a sense of urgency. Incentives for participants were not offered. The recruitment strategy prioritized:

Approachability: Reducing avoidant fear responses by framing the screening tests within the context of an overall 'prostate health check'.

Accessibility: Reducing the potential for disengagement by ensuring respondents were not overwhelmed with information and using a step-wise approach.

Relevance: Highlighting study was for all men aged 50−69 with or without symptoms.

2.3. Recruitment methods

The recruitment methods for IP1-PROSTAGRAM were three-fold (Fig. 2). The study team asked whether potential participants had heard of the study from two different routes and, if so, which route made them wish to enquire further:

Direct Mail: Letters or text messages to invite participants registered with a general practitioner (GP).

Media: Print, broadcast, or social media not targeted towards any ethnic or socioeconomic group.

Targeted: Community hubs and community group leaders as advocates of the study, as well as general word-of-mouth.

2.4. Direct mail (non-targeted)

Seven primary care practices in North West London ran database searches using pre-defined eligibility criteria (Supplementary Table 1). A GP further screened lists to remove any with other co-morbidities and/or frailty limiting life expectancy and potential benefit from screening, or other reasons making it inappropriate for invitation. All

What is new?

Key findings

- We found that direct mail strategy to recruit into a prostate cancer screening study was effective at reflecting the diversity of the local population. In addition, a targeted strategy designed to engage the Black community was effective at recruiting high numbers of participants from this ethnic group.

What this adds to what is known?

- We know that diversity of participation in trials, particularly of prostate cancer, can be problematic due to a number of complex cultural and socioeconomic factors. Our study aimed to deal with these and evaluate a recruitment strategy that could be used in population-based screening studies particularly given the higher risk of prostate cancer in Black men.

What is the implication and what should change now?

- These findings will allow the design of a larger definitive screening study evaluating new methods of ruling-out and detecting prostate cancer that might be used in the community. Ensuring representation of the population is critical to ensuring that subsequent study, and others, have robust external validity.

men from the primary care list were sent an invitation letter through Docmail (Supplementary Fig. 1) with an information leaflet (Supplementary Fig. 2); an initial short message service was used by two GP practices (Supplementary Fig. 3). The letter was designed to reduce fear-based barriers by inviting potential participants to a 'Prostate Health Check' rather than a 'Prostate Cancer Screening Test with the letter signed by the named GP.

A leaflet accompanied the letter expanded upon further details to reduce information burden. The leaflet design process involved a competition amongst graphic designers and over one hundred design options submitted which were shortlisted by patient representatives and the final design chosen by a patient and public involvement (PPI) focus group. A shortlisting process was led by the patient representatives of the trial management group who shortlisted five designs. The final design was chosen from this shortlist by the PPI focus group that used an online voting system which implemented a ranked choice voting. Using this system each member of the PPI group ranked the designs in order of preference with votes counted in a series of rounds with the flier who received fewest first preferences being eliminated at each round until a final design was selected.

2.5. Media strategy (non-targeted)

Multiple nontargeted media strategies were employed concurrently. These included newspaper and radio advertisements and websites in combination with social media channels:

Newspaper/radio: Adverts were placed in newspapers within the local area supplemented with announcements on radio stations covering Northwest London.

Social media: Accounts with high social capital in the context of prostate cancer posted information about the trial (Supplementary Fig. 4).

Study website: A website where participants could directly register for the study (http://imperialprostate.org.uk/prostagram/) (Supplementary Fig. 5).

2.6. Targeted recruitment

The targeted recruitment strategy was designed with the specific aim of promoting the study amongst black men and lower socioeconomic groups. Given that a key barrier to participation by ethnic minority groups in clinical trials is mistrust of the medical community and medical research [19], we sought to tackle this by:

Building an ethnically diverse recruitment team who were key to ensuring the messaging was culturally appropriate. The recruitment team included four members of staff, two of whom were from the local black community. Members of the recruitment team were also empowered to become minority recruitment champions and use their community links where appropriate.

Community leaders as advocates to drive word of mouth. These included a pastor from a local church and a police officer. The team also worked in collaboration with online local communities such as the National Black Women's Network (NBWM) to engage.

Posters: in areas identified as having high levels of deprivation and ethnic diversity using the index of multiple deprivation (IMD2019) posters and leaflets were placed in community hubs and gathering places such as church halls, libraries, supermarkets and pubs. The poster was developed using the same process as the leaflet (Supplementary Fig. 6).

2.7. Sociodemographic measures

Ethnicity was self-reported by participants according to a standardized list of official ethnic groups provided by the Office for National Statistics. Participants reported as 'mixed' or 'other' for ethnicity were grouped into a single category due to low numbers in each group. The IMD was used to

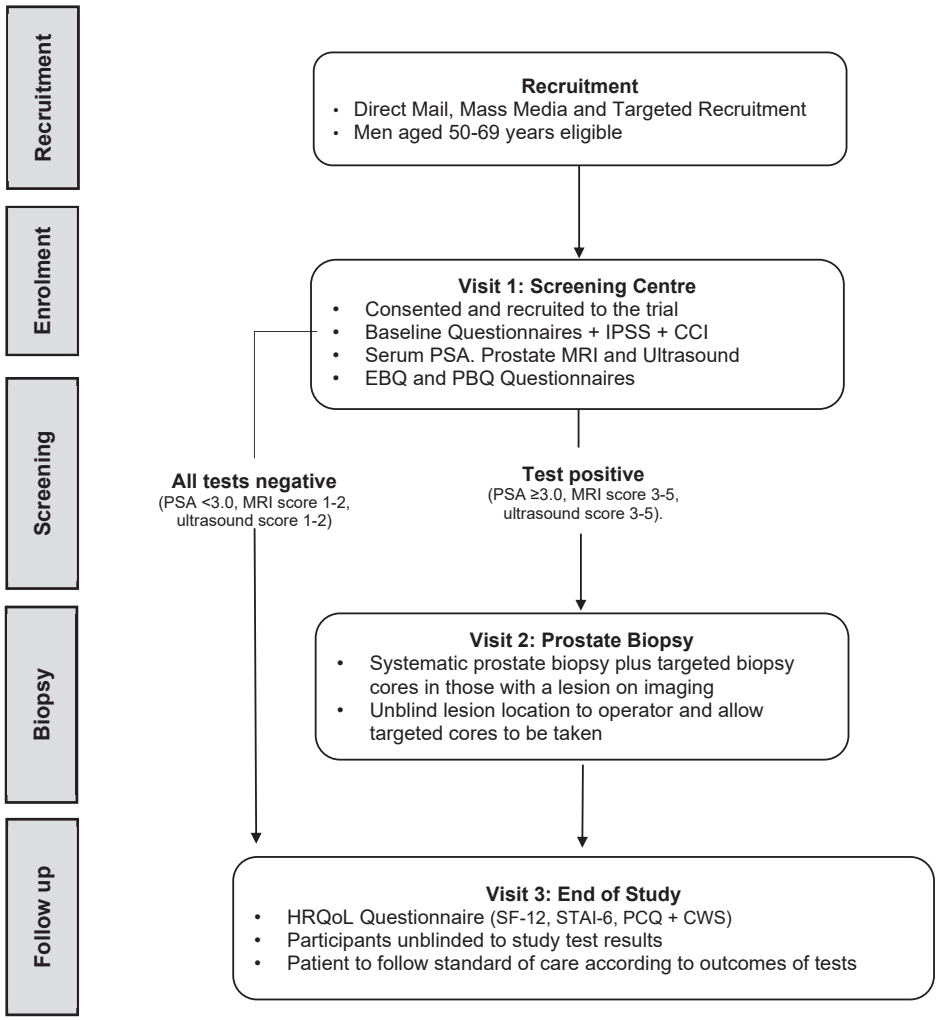

Fig. 1. IP1-PROSTAGRAM Trial Study Schema. *Abbreviations*: IPSS, international prostate symptom score; CCI, charlson comorbidity index; PSA, prostate specific antigen; MRI, magnetic resonance imaging; EBQ, expected burden questionnaire; PBQ, perceived burden questionnaire; HRQoL, health related quality of life; SF-12, twelve item short form; STAI-6, six item state-trait anxiety inventory; PCQ, psychological consequences questionnaire; CWS, cancer worry scale.

measure socioeconomic status and is a widely used measure of deprivation in England being a composite measure of seven weighted domains of deprivation for each area including Income; Employment; Education; Skills and Training; Health and Disability; Crime; Barriers to Housing Services; Living Environment. The IMD can be presented as a rank from the most deprived area (=1) to the least deprived area (=32,844). For categorical presentation these can be divided into quintiles and quintile 1 is equivalent to areas 1 to 6,569 (most deprived) increasing to quintile 5, equivalent to areas 26,275 to 32,844 (least deprived).

2.8. Statistical Analysis

Chi-squared squared tests of independence were used to compare differences in ethnicity and index of multiple deprivations between each screening tests. Other differences in sociodemographic variables such as education levels, marital status qualifications, BMI, family history of prostate cancer, Charlson Comorbidity Index (CCI), and smoking history were compared with chi squared for categorical or Kruskall Wallis for continuous. As ethnicity and family history status was not collected from screened groups it was not possible to look at differences in these factors between those who had participated and those who had not. For the secondary outcome comparing responders and nonresponders invited by letter, the association between age, IMD, and response to invitation were evaluated using binomial logistic regression. Adjusted odds ratios were used to compare the proportion of responders and nonresponders by response rate and recruitment rate. T tests were used to compare the mean deprivation score and age between responders and nonresponders. All analyses were conducted in the R Version 4.0.2 [20] using R Studio Version 1.3.1073.

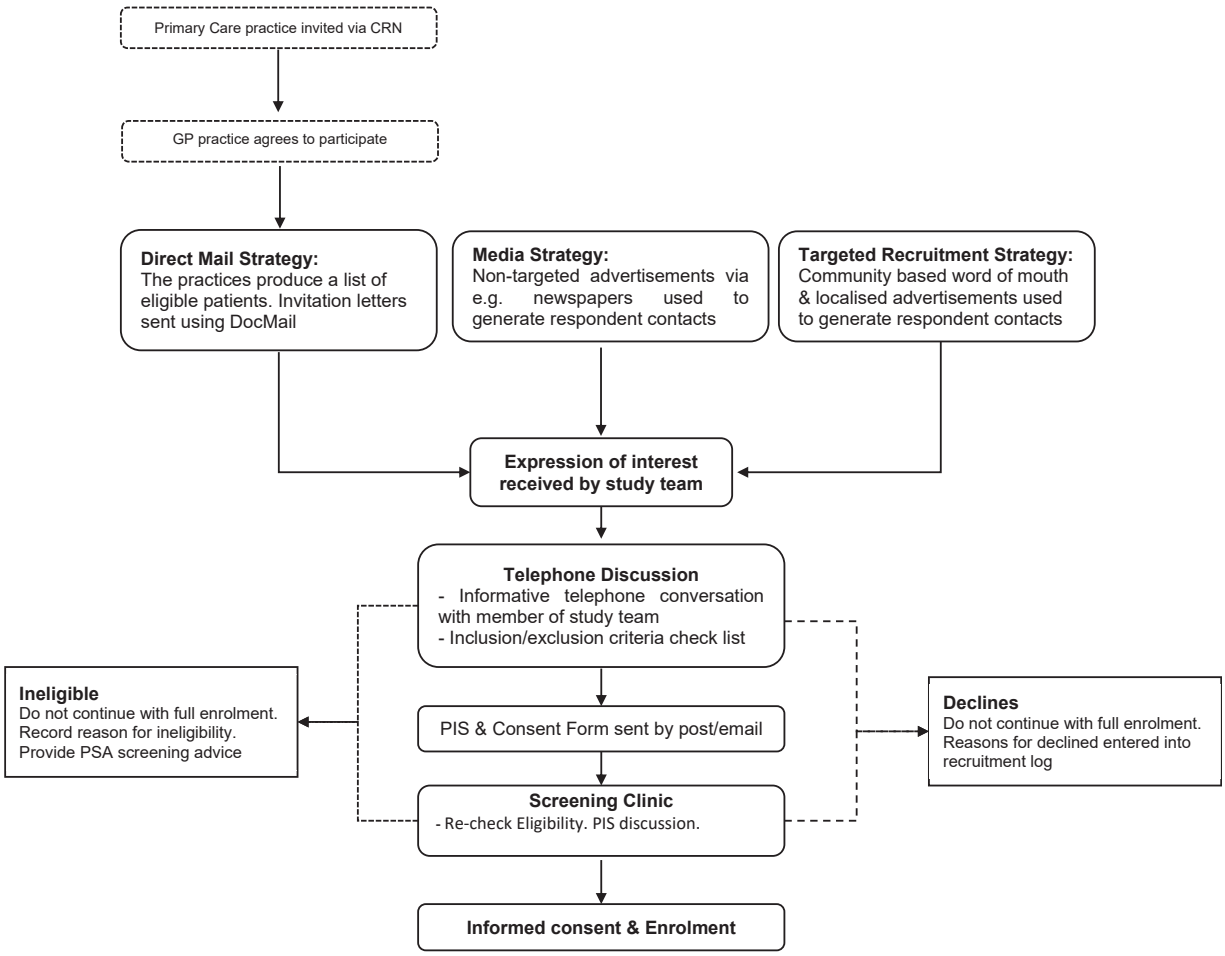

Fig. 2. Recruitment flowchart for IP1-PROSTAGRAM. *Abbreviations*: PIS, participant information sheet; CRN, clinical research network.

3. Results

A total of 1,316 expressions of interest were received (20th September 2018 to 15th May 2019) with the direct mail generating 317 from 1707 invitation letters, 612 from the media campaign and 387 from targeted recruitment strategy. Only one participant had heard of the study from two different recruitment strategies.

The direct mail strategy commenced in September 2018 and achieved a consistent rate throughout the study period. In contrast, the responses received due to the media and targeted strategies were intermittent and related to timing of study team interventions. The media campaign had minimal response until a tweet by a prominent prostate cancer patient with 12.6 million followers. This tweet had 9,396 views and generated 1,534 referrals to the study website with 587 expressing an interest over a 48-hour period (Fig. 3A).

From the 1,316 expressions of interest, 42.2% ($n = 554$) of potential participants were contactable for telephone prescreening (Fig. 4). The high number of expressions of interest meant that the study achieved rapid recruitment and completed 19 months ahead of schedule (Fig. 3B).

3.1. Study participants compared to local population

Ethnicity: The ethnicity of the 411 participants was distributed across White (38.0%), Black (32.4%), Asian (23.0%), and Other/Mixed (4.4%) ethnic groups. In total, a higher proportion of Black men than would expected given the local population participated (Fig. 5A), driven by the targeted recruitment strategy.

Index of Multiple Deprivation: The IMD distribution of study participants was similar to the local population (Fig. 5B). The distribution of participants is marginally left skewed towards recruitment of men from more deprived areas with the proportion increasing from 26% to 40% from least to most deprived IMD quintiles (Quintiles 4 and 5 vs. Quintiles 1 & 2).

3.2. Ethnicity and index of multiple deprivation by recruitment method

Ethnicity: A comparison of recruitment methods showed marked differences between ethnicities recruited ($P < 0.001$) (Supplementary Fig. 7A). The proportion

of Black men recruited by direct mail (8%) was similar to the prevalence of Black men in the local population (9%). The number of Black men recruited by targeted recruitment was high (88%, $n = 115$) and low for media recruitment (1.7%, $n = 1$). In contrast, the ethnicity of men recruited by the media strategy was predominately White (93%) and from the least deprived socioeconomic group (Table 1).

Index of Multiple Deprivation: Each recruitment method also produced differences in IMD quintiles although not as marked as ethnicity (Supplementary Fig. 7B). Direct mail recruited a close-to-normal distribution, media recruited from the least deprived areas and targeted recruitment trended towards recruiting from most deprived areas.

3.3. Other sociodemographic variables

The targeted strategy recruited a younger cohort compared to media or direct mail ($P < 0.001$) (Table 1). Men were more likely to report a significant family history of prostate cancer if recruited by the direct mail strategy. There was no significant difference in the level of qualifications, marital or employment status, BMI, co-morbidities or smoking history. The seven Primary Care Practices were predominantly located in more deprived areas as defined by IMD Quintile (Table 2). Of 1,707 who received an invitation, 18.6% ($n = 317$) contacted the study team to express an interest with 219 (12.8%) recruited following further explanation and eligibility checks. The remaining either declined to participate (2.3% $n = 39$), could not be contacted (1.3%, $n = 22$) or did not meet eligibility criteria (2.9%, $n = 50$). The most common reasons for not being eligible were a previous PSA within 2 years ($n = 22$), insufficient English for consent ($n = 17$) or a contraindication to MRI ($n = 5$). The invitations were sent by the primary care practice either by letter (80.2%, $n = 1,370$) or text message (19.7%, $n = 337$). The response rate from letters was significantly higher than text (22.7% [95% CI 20.5–25.0] vs. 5.6% [95% CI 3.4–8.7], $P < 0.001$). The response rate between individual practices sending letters ranged from 13.8% to 28.0% while response to text messages was similar in the two practices using this (5.5% and 5.8%) (Table 2).

3.4. Sociodemographic variation in response to invitation letter

22.7% (311/1,370) responded to invitation by letter (Fig. 6A). Responders were older (mean age 58.9 years [SD5.36] vs. 57.2 years [SD5.27], $P < 0.001$). Distribution of IMD deprivation was comparable between responders and nonresponders (mean IDM 16,580 [SD6371] vs. 17,006 [SD6972], $P < 0.001$). These trends were confirmed multivariate analysis (Table 3). Participants who agreed to participate were older (65–69 years, OR 2.21 [95% CI 1.44–3.36], $P < 0.01$). There was no association between IMD and participating.

4. Discussion

A range of recruitment strategies were evaluated within the IP1-PROSTAGRAM trial including a targeted recruitment strategy tailored to improve engagement of hard-to-reach groups. The results show that the targeted recruitment strategy was capable of recruiting more men from Black ethnicity lower socioeconomic groups compared to the direct mail or media strategy.

The findings for the media strategy were mixed. Although it generated a high number of responses, it was driven by one particular social media post and men recruited via the media strategy were 93% White and from the least deprived socioeconomic group. Other attempts to generate media interest using traditional forms of recruitment such as newspapers and radio advertising generated minimal responses. Newspapers and radio adverts had limited reach and the nonpersonalized nature of the adverts. The adverts, particularly in the

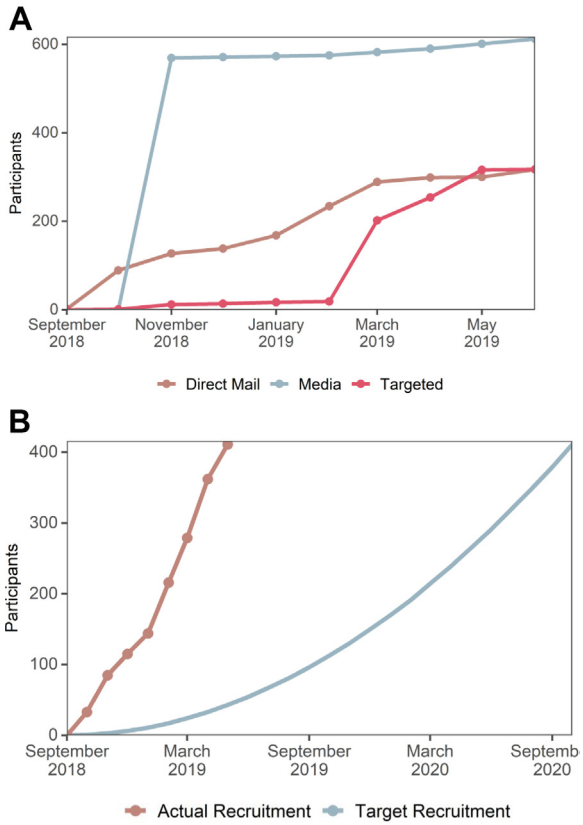

Fig. 3. (A) Cumulative expressions of interest received by each screening recruitment method and (B) Cumulative total study recruitment compared to expected recruitment.

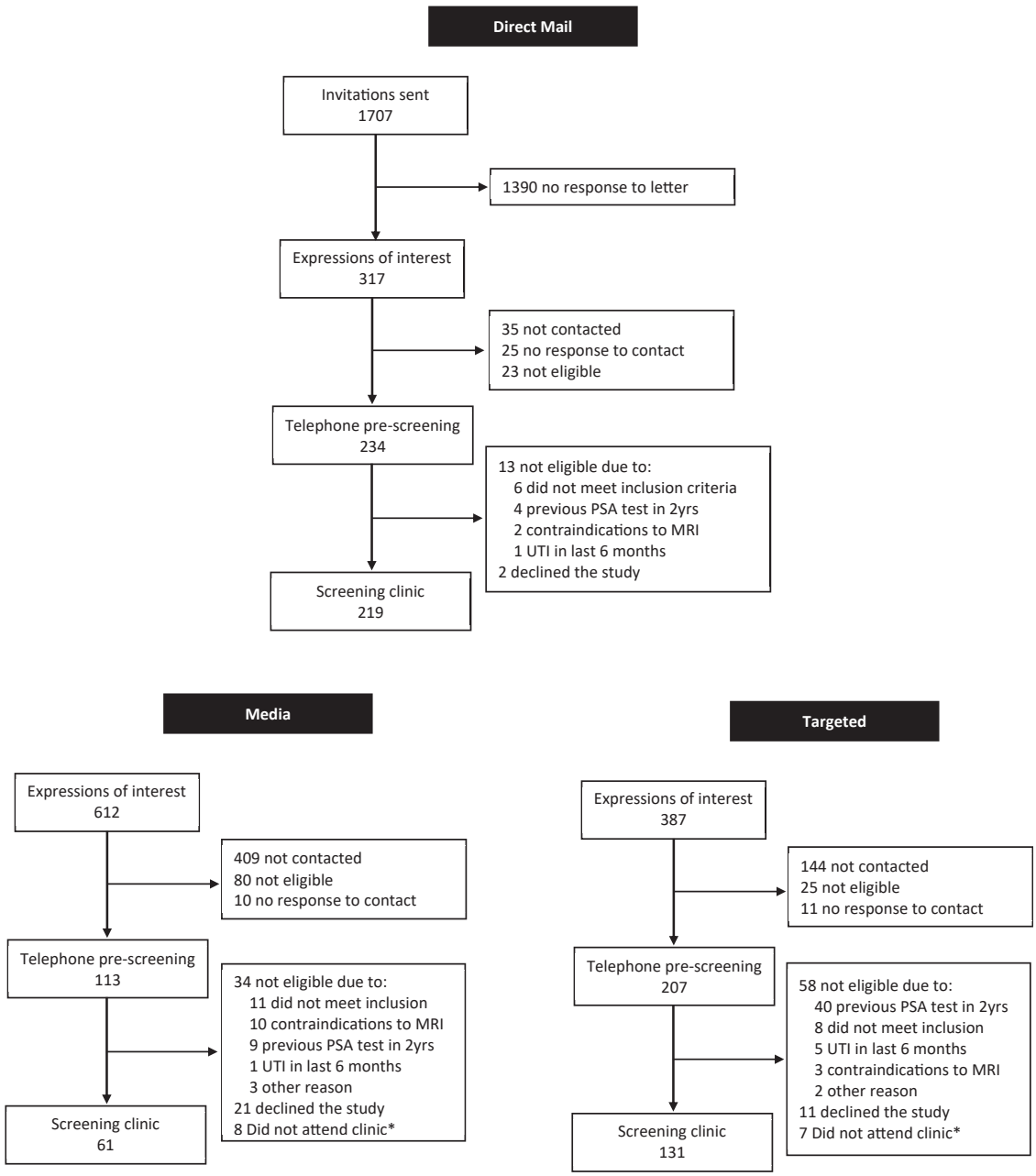

Fig. 4. Expressions of interest received and flow of participants by each recruitment method.

newspapers, would be amongst many other heavy texts. In addition, there were constraints to the information that could be provided on newspaper articles. In addition, alternative attempts to drive recruitment using social media profiles of prostate cancer charities generated few responses.

Direct mail gave a response rate from letter invitation that was four-fold higher than from text messages. A comparison of responders and nonresponders to the postal invitations showed that this strategy was capable of recruiting men from a diverse spectrum of socioeconomic backgrounds that reflected the local population. These findings suggest the letter and leaflet design were appropriate for their objectives. Direct mail recruitment was able to provide more information than a text message and could be personalized to the patient by being signed off by their own GP. Previous studies have shown that a personalized cover letter from a patients' GP is an important factor in participating in clinic trials

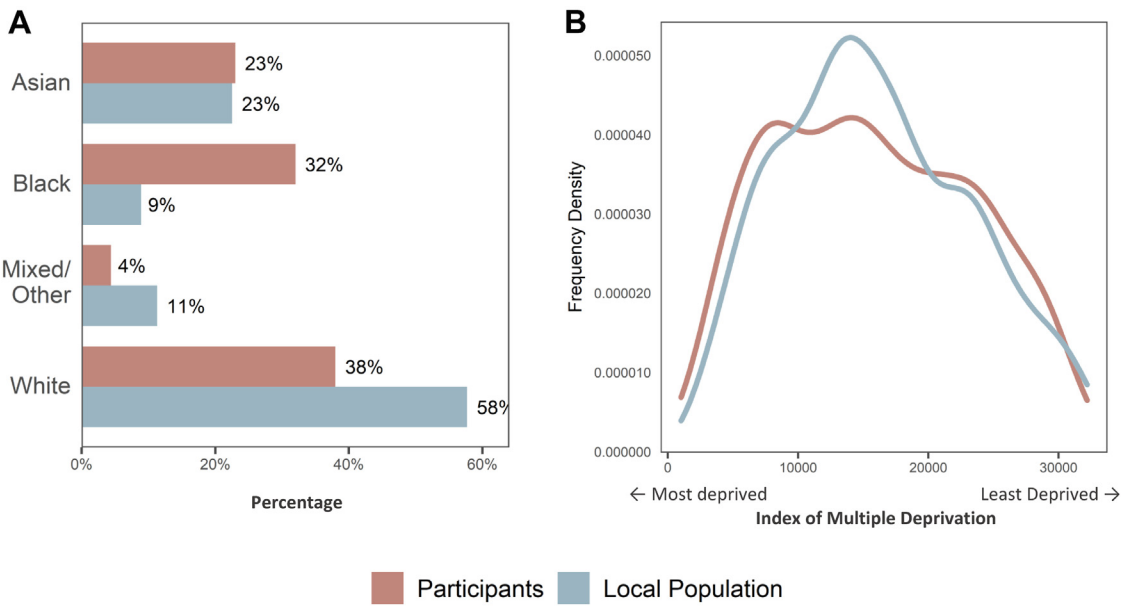

Fig. 5. Ethnic group and Index of Multiple Deprivation in study participants compared to local population. Local population calculated from men aged 50 to 69 years in ethnic groups within boroughs of Chelsea, Hammersmith and Fulham, Harrow, Hillington, Islington, and Kensington. Data from Office of National Statistics, Annual Population Survey 2018 (A) Bar charts of ethnicity by four major ethnic groups (B) Kernel density plot of Index of Multiple Deprivation.

[21]. This study provides further support into the benefits of personalization when approaching patients in primary care.

These findings are consistent with experiences of other cancer screening trials in which targeted strategies can significantly increase enrolment of high-risk and hard-to-reach individuals [22]. Given that cultural perceptions play a significant role in determining the willingness of minority populations to participate in clinical trials [23] dedicated recruitment strategies provide the optimal method to build trust and alleviate specific cultural barriers to participation. Similar to previous studies, enlisting 'cultural insiders' and staff members who had the trust of the target population was a highly successful method for reaching and recruiting minority participants [24].

Compared to other population screening trials, IP1-PROSTAGRAM recruited a higher proportion of Black men as well as men from a lower socioeconomic background (Supplementary Table 2). Both PLCO [13] and Cluster Randomized Trial of PSA Testing for Prostate Cancer (CAP) [14] have reported that participants were skewed towards men of a higher socioeconomic status. In IP1-PROSTAGRAM cohort, there were more men from a lower socioeconomic group due to the influence of the targeted recruitment strategy.

The higher levels of socioeconomic deprivation in the local area could be a factor in the lower response rates to postal invitations we saw (22.7%) and do differ compared to previous prostate cancer screening studies showing the difference in response rate between this study and previous population-based screening trials [14,18,25,26] (Supplementary Table 3). Other studies did use repeated invitations, had considerable infrastructure support, and delivered a single noninvasive screening test which might have contributed to the response rates. In IP1-PROSTAGRAM, due to the rapid recruitment from other recruitment strategies, the study completed before Primary Care Practices could send second invitations to nonresponders. Previous population-based screening studies have increased response rates from sending reminder invites with scheduled appointments [18]. In cervical cancer, screening a reminder letter with a pre-booked appointment increased participation two-fold compared to a single open invitation [27]. Many large population screening randomized control trials (RCTs) have also used a single-consent Zelen design. Finally, there are many psychosocial barriers to prostate cancer screening particularly in certain ethnic groups and especially where it involves rectal procedures [28].

The finding that direct mail may be the optimal approach as the core recruitment strategy highlights the importance in selection of recruitment sites for screening trials accounting for the potential for minority recruitment in each area although settings with low rates of ethnic diversity compared to the rest of the world will inherently not be able to enrich studies with diversity of ethnicity [18].

There are some limitations. First, we did not know the ethnicity of nonparticipants due to data protection. Sec-

Table 1. Sociodemographic, Prostate Risk Factors and Medical History of participants in the IP1-PROSTAGRAM study (n = 411)

Variable	Direct mail N = 219	Media N = 61	Targeted recruitment N = 131	P-value[a]
Sociodemographic				
Age at invitation (yr)	58 (54–63)	58 (52–61)	55 (53–58)	<0.001
Ethnicity				<0.001
Asian	90 (42%)	2 (3.3%)	2 (1.5%)	
Black	18 (8.4%)	1 (1.7%)	115 (88%)	
Mixed	7 (3.3%)	1 (1.7%)	1 (0.8%)	
Other	11 (5.1%)	0 (0%)	0 (0%)	
White	88 (41%)	56 (93%)	12 (9.2%)	
Index of Multiple Deprivation Quintile				<0.001
1 (most deprived)	20 (9.1%)	3 (4.9%)	31 (24%)	
2	53 (24%)	10 (16%)	47 (36%)	
3	94 (43%)	13 (21%)	34 (26%)	
4	38 (17%)	12 (20%)	12 (9.2%)	
5 (least deprived)	14 (6.4%)	23 (38%)	7 (5.3%)	
Qualification				0.361
No Qualifications	20 (9.3%)	5 (8.3%)	5 (3.8%)	
GCSEs or O levels	35 (16%)	6 (10%)	28 (22%)	
A-levels o equivalent	24 (11%)	13 (22%)	11 (8.5%)	
University degree	119 (55%)	35 (58%)	76 (58%)	
Other	17 (7.9%)	1 (1.7%)	10 (7.7%)	
Married/Civil Partnership	173 (79%)	51 (84%)	96 (74%)	0.382
Employed	172 (80%)	42 (69%)	99 (76%)	0.254
Prostate Cancer Risk				
BMI	27.2 (3.8)	27.0 (3.3)	27.8 (4.2)	0.3
Family History (1st)[b]	42 (19%)	0 (0%)	2 (1.6%)	<0.001
Family History (Any)[c]	53 (24%)	0 (0%)	28 (22%)	<0.001
Medical History				
IPSS Score	4 (2–8)	4 (2–9)	5 (2–10)	0.4
Charlson Comorbidity Index (CCI)				0.2
0	165 (78%)	49 (80%)	113 (88%)	
1	40 (19%)	11 (18%)	12 (9.3%)	
2	6 (2.8%)	1 (1.6%)	4 (3.1%)	
Smoking history				0.6
Current Smoker	28 (13%)	4 (7.1%)	16 (13%)	
Ex-Smoker	58 (27%)	20 (36%)	35 (28%)	
Never Smoker	126 (59%)	32 (57%)	72 (59%)	

[a] Statistical tests performed: Kruskal-Wallis test; chi-square test of independence. No adjustments were made for multiple comparisons.
[b] A first degree family member.
[c] A first or second degree family member.

ond, our strategy was mainly focused in London and on the black community where there was a particular interest in recruiting a known group of the population at higher risk of prostate cancer; further research is needed in other locations and other ethnic groups. Third, while responders and nonresponders were similar in terms of deprivation level, it cannot be excluded that other important factors such as education, marital status or household income could have influenced this as shown by others [29]. Fourth, response rates for the majority of recruitment methods could not be calculated due to the nature of strategies such as word-of-mouth or posters as it was unknown how many heard about the study via these methods. Fifth, primary care practices self-selected whether to send invitations via letter or short message service and we did not have data on undelivered letters or

Table 2. Response rates for letters and text messages by Primary Care Practice

Type of invite by practice number	IMD[a] quintile	Invitations sent	Response rate[b]	Ineligible Rate[c]	Decline rate[d]	Recruitment Rate[e]
Letters						
Practice 1	4	500	28.0% (140/500)	3.6% (18/500)	3.2% (16/500)	21.2% (106/500)
Practice 2	1	253	26.9% (68/253)	4.3% (11/253)	9.5% (24/253)	13.0% (33/253)
Practice 3	4	222	14.9% (33/222)	3.2% (7/222)	1.8% (4/222)	9.9% (22/222)
Practice 4	4	235	20.4% (48/235)	3.4% (8/235)	4.3% (10/235)	12.8% (30/235)
Practice 5	3	160	13.8% (22/160)	1.3% (2/160)	3.1% (5/160)	9.4% (15/160)
Overall		1,370	22.7% (311/1,370)	3.1% (42/1,370)	3.2% (44/1,370)	13.8% (189/1,370)
Text Messages						
Practice 6	2	200	5.5% (11/200)	1.0% (2/200)	4.3% (9/200)	4.0% (8/200)
Practice 7	1	137	5.8% (8/137)	1.5% (2/137)	0.5% (1/137)	3.6% (5/137)
Overall		337	5.6% (19/337)	1.2% (4/337)	0.7% (2/337)	3.9% (13/337)

All percentages calculated using invitation sent as denominator.
[a] IMD by Lower layer Super Output Areas for each Primary Care Practice by postcode.
[b] Proportion of expressions of interest received via telephone due to invitation.
[c] Proportion who found to be ineligible during telephone screening.
[d] Proportion who declined or could not be contacted after expressing an interest.
[e] Proportion who were recruited to the study.

texts due to out-of-date contact details. This nonrandomized design has inherent bias and does not account for differences in the population of the practices. Despite the nonrandomized design, our findings are similar results to previous studies showing a lower uptake via text message recruitment [30]. Last, the primary care practices were from within a clinical research network so had experience in engaging patients with research.

5. Conclusion

The participation of minorities is essential to ensuring results of screening trials are generalizable across the population. Our findings suggest that, where invitation materials have been designed to engage a diverse population, it is possible to achieve a representative uptake (including black men and those from a lower socioeco-

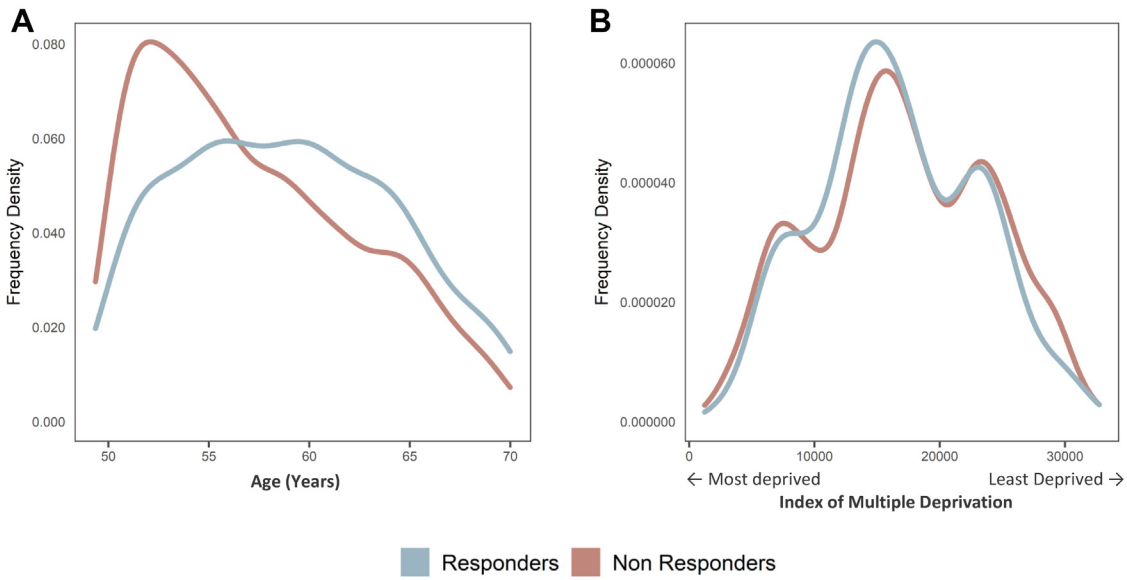

Fig. 6. Kernel density plots for responders and nonresponders to letters by (A) Age at invitation and (B) Index of Deprivation.

Table 3. Multivariate analysis for predictors of response and recruitment rate

	Response to invitation[a]		Recruited[b]	
Variable	**Odds ratio (95% CI)**	***P*-value**	**Odds ratio (95% CI)**	***P*-value**
Age (yr)				
50–54	1.00	Ref	1.00	Ref
55–60	1.62 (1.16–2.28)	0.005	1.81 (1.16–2.82)	0.009
60–64	2.17 (1.52–3.09)	<0.001	2.04 (1.40–1.70)	0.003
65–69	2.21 (1.44–3.36)	<0.001	2.52 (1.47–4.27)	<0.001
Index of multiple variations				
Quintile 1 (least deprived)	1.00	Ref	1.00	Ref
Quintile 2	1.47 (0.25–28.1)	0.72	1.89 (0.36–28.9)	0.76
Quintile 3	1.97 (0.44–37.4)	0.53	2.04 (0.48–37.8)	0.62
Quintile 4	1.49 (0.26–28.3)	0.71	1.43 (0.21–27.9)	0.81
Quintile 5 (most deprived)	1.42 (0.24–27.0)	0.75	1.22 (0.14–27.1)	0.82

For each variable, the odds ratio describes the odds of the outcome of the given category relative to the reference category.
[a] Analysis categorized individuals into nonresponders or responders to the invitation by letter.
[b] Analysis categorized men into those recruited and not recruited (including nonresponders).

nomic group) from direct mail recruitment. Targeted recruitment strategies can be used if the study wished to enrich participation from a particular socioeconomic or ethnic group.

Appendix B

Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclinepi.2022.05.018.

References

[1] Ben-Shlomo Y, Evans S, Ibrahim F, Patel B, Anson K, Chinegwundoh F, et al. The risk of prostate cancer amongst black men in the United Kingdom: the PROCESS cohort study. Eur Urol 2008;53(1):99–105.
[2] Chu KC, Tarone RE, Freeman HP. Trends in prostate cancer mortality among black men and white men in the United States. Cancer 2003;97(6):1507–16.
[3] Ferlay J, Soerjomataram I, Dikshit R, Eser S, Mathers C, Rebelo M, et al. Cancer incidence and mortality worldwide: sources, methods and major patterns in GLOBOCAN 2012. Int J Cancer 2015;136:E359–86.
[4] Phillips AA, Jacobson JS, Magai C, Consedine N, Horowicz-Mehler NC, Neugut AI. Cancer incidence and mortality in the Caribbean. Cancer Invest 2007;25(6):476–83.
[5] Bouchardy C, Verkooijen HM, Fioretta G. Social class is an important and independent prognostic factor of breast cancer mortality. Int J Cancer 2006;119:1145–51.
[6] Downs LS, Smith JS, Scarinci I, Flowers L, Parham G. The disparity of cervical cancer in diverse populations. Gynecol Oncol 2008;109(2):S22–30.
[7] Carsin A, Sharp L, Cronin-Fenton D, Céilleachair AÓ, Comber H. Inequity in colorectal cancer treatment and outcomes: a population-based study. Br J Cancer 2008;99:266–74.
[8] Berglund A, Garmo H, Robinson D, Tishelman C, Holmberg L, Bratt O, et al. Differences according to socioeconomic status in the management and mortality in men with high risk prostate cancer. Eur J Cancer 2012;48(1):75–84.
[9] Rapiti E, Fioretta G, Schaffar R, Neyroud-Caspar I, Verkooijen HM, Schmidlin F, et al. Impact of socioeconomic status on prostate cancer diagnosis, treatment, and prognosis. Cancer 2009;115(23):5556–65.
[10] Pinsky PF, Prorok PC, Yu K, Kramer BS, Black A, Gohagan JK, et al. Extended mortality results for prostate cancer screening in the PLCO trial with median follow-up of 15 years. Cancer 2017;123(4):592–9.
[11] Hamdy FC, Donovan JL, Lane JA, Mason M, Metcalfe C, Holding P, et al. 10-Year outcomes after monitoring, surgery, or radiotherapy for localized prostate cancer. N Engl J Med 2016;375(15):1415–24.
[12] Schröder FH, Hugosson J, Roobol MJ, Tammela TLJ, Zappa M, Nelen V, et al. Screening and prostate cancer mortality: results of the European randomised study of screening for prostate cancer (ERSPC) at 13 years of follow-up. Lancet 2014;384:2027–35.
[13] Pinsky P, Miller A, Kramer B, Church T, Reding D, Prorok P, et al. Evidence of a healthy volunteer effect in the prostate, lung, colorectal, and ovarian cancer screening trial. Am J Epidemiol 2007;165:874–81.
[14] Walsh EI, Turner EL, Lane JA, Donovan JL, Neal DE, Hamdy FC, et al. Characteristics of men responding to an invitation to undergo testing for prostate cancer as part of a randomised trial. Trials 2016;17(1):497.
[15] Eldred-Evans D, Burak P, Connor MJ, et al. Population-based prostate cancer screening with magnetic resonance imaging or ultrasonography: the IP1-PROSTAGRAM study. JAMA Oncol 2021;7(3):395–402.
[16] Field JK, Duffy SW, Baldwin DR, Day E, Evans M, Fiorentino F, et al. UK Lung Cancer RCT Pilot Screening Trial: baseline findings from the screening arm provide evidence for the potential implementation of lung cancer screening. Thorax 2016;71(2):161–70.
[17] Kummer S, Waller J, Ruparel M, Duffy SW, Janes SM, Quaife SL. Psychological outcomes of low-dose CT lung cancer screening in a multisite demonstration screening pilot: the Lung Screen Uptake Trial (LSUT). Thorax 2020;75(12):1065–73.
[18] Quaife SL, Ruparel M, Dickson JL, Beeken RJ, McEwen A, Baldwin DR, et al. Lung screen uptake trial (LSUT): randomized controlled clinical trial testing targeted invitation materials. Am J Respir Crit Care Med 2020;201:965–75.
[19] Corbie-Smith G, Thomas SB, Williams MV, Moody-Ayers S. Attitudes and beliefs of African Americans toward participation in medical research. J Gen Intern Med 1999;14:537–46.
[20] R Core Team. R. A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing; 2013. Available at https://www.R-project.org/. Accessed December 23, 2020.

[21] Reed RL, Barton CA, Isherwood LM, Baxter JM, Roeger L. Recruitment for a clinical trial of chronic disease self-management for older adults with multimorbidity: a successful approach within general practice. BMC Fam Pract 2013;14:125.
[22] Weller DP, Patnick J, McIntosh HM, Dietrich AJ. Uptake in cancer screening programmes. Lancet Oncol 2009;10(7):693−9.
[23] Duda C, Mahon I, Chen MH, Snyder B, Barr R, Chiles C, et al. Impact and costs of targeted recruitment of minorities to the national lung screening trial. Clin Trials 2011;8:214−23.
[24] Hinshaw LB, Jackson SA, Chen MY. Direct mailing was a successful recruitment strategy for a lung-cancer screening trial. J Clin Epidemiol 2007;60:853−7.
[25] Roobol MJ, Kranse R, Bangma CH, van Leenders AG, Blijenberg BG, van Schaik RH, et al. Screening for prostate cancer: results of the rotterdam section of the European randomized study of screening for prostate cancer. Eur Urol 2013;64(4):530−9.
[26] Grönberg H, Adolfsson J, Aly M, Nordström T, Wiklund P, Brandberg Y, et al. Prostate cancer screening in men aged 50−69 years (STHLM3): a prospective population-based diagnostic study. Lancet Oncol 2015;16(16):1667−76.
[27] Virtanen A, Anttila A, Luostarinen T, Malila N, Nieminen P. Improving cervical cancer screening attendance in F inland. Int J Cancer 2015;136:E677−84.
[28] Weinrich SP, Reynolds WA Jr, Tingen MS, Starr CR. Barriers to prostate cancer screening. Cancer Nurs 2000;23(2):117−21.
[29] Nijs HGT, Essink-Bot ML, DeKoning HJ, Kirkels WJ, Schröder FH. Why do men refuse or attend population-based screening for prostate cancer? J Public Health Med 2000;22(3):312−6.
[30] Toledano MB, Smith RB, Brook JP, Douglass M, Elliott P. How to establish and follow up a large prospective cohort study in the 21st century-lessons from UK COSMOS. PLoS One 2015;10:e0131521.