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A bilingual, Internet-based, targeted advertising campaign for prostate cancer clinical trials: Assessing the feasibility, acceptability, and efficacy of a novel recruitment strategy

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ABSTRACT

Background: To address limitations in recruitment and enrollment of diverse, low-literacy patients into prostate cancer clinical trials, we evaluated the feasibility, acceptability, and efficacy of an English and Spanish, Internet-based, multilevel recruitment intervention.

Methods: Intervention components included (1) a low-literacy, bilingual, automated, Internet-based clinical trial matching tool; (2) a bilingual nurse who assisted individuals with questions and enrollment; and (3) a targeted, Internet-based advertising campaign. We evaluated (a) completion of matching tool, (b) expression of interest in a clinical trial, (c) number of patients who matched to clinical trials at a single institution, (d) discussion of risks and benefits of clinical trials (via follow-up interviews), and (e) effect of the advertising on completing the matching tool. Feasibility, acceptability, and preliminary estimates of efficacy were measured through user engagement with the matching tool and subsequent qualitative interviews with these same users.

Results: During the 28-week study period, 523 users provided demographic information, 263 were identified with prostate cancer, 192 (73%) matched to at least one clinical trial, and 29 (15.1%) of those who matched provided contact information. During the study period, 17 prostate cancer clinical trials were available for matching. We completed follow-up interviews with 14 of the 29 men who provided contact information. Of the 14, 85.7% discussed the risks and benefits of clinical trials with their physician, and 35.7% enrolled in a clinical trial. The Internet-based advertising campaign resulted in an increased number of matching tool completions.

Conclusions: Our study demonstrates that an Internet-based clinical trial matching tool that is advertised using a targeted Internet-based campaign can provide an effective means to reach diverse, low-literacy patients. When implemented at scale and over a longer duration, such interventions may help increase trial participation among underrepresented populations.

1. Introduction

Advances in cancer diagnosis and treatment depend on the voluntary participation of diverse and representative patients in clinical trials [1]. However, in the United States, less than 5% of all eligible adult cancer patients participate in clinical trials [2]. Clinical trial enrollees tend to be well-educated, middle class, and Caucasian, and as a result, the problem of underrepresentation of minorities in clinical trials

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persists [3,4]. New strategies are required to improve recruitment of underrepresented populations into cancer clinical trials. The Internet is a logical resource for clinical trial advertisement and recruitment as almost 86% of the U.S. population has regular access to the Internet [5]. Importantly, African Americans and Latinos have doubled their use of the Internet in the last decade [6,7], making it a potentially important tool in strategies designed to increase participation of these underrepresented groups.

Although several Internet-based clinical trial matching tools have been developed, these tools are limited in scope and not designed to be patient-friendly [8,9]. Users typically receive a list of trials with principal investigator (PI) or site contact information, and eligibility criteria often are described in complex medical jargon. Some tools offer limited custom matching of individuals to trials, but these often require registration. Most tools are only available in English, which may limit minority participation, and many are not tailored to individuals with limited health literacy. A national database of clinical trials that was developed to facilitate enrollment showed a positive impact on matching and recruiting patients into prevention trials; however, this database did not facilitate final enrollment [10], suggesting a need for further engagement (e.g., personal interaction) and patient navigation once a possible match is identified [10–12]. Additionally, a study of users of a breast cancer clinical trials matching tool showed that those who did not find their match results “relevant” cited that most of the trials matched to them were located far away [13]. Finally, most existing clinical trial matching tools lack an individualized service that could answer patients' or family members' questions. Some sites may offer a phone service, though this is meant to guide callers through the matching process without offering additional information about the trial or alternatives to participating in the trial. These limitations result in inadequate recruitment and enrollment of diverse, low-literacy patients into cancer clinical trials.

The utility of the Internet to disseminate health information to minority Americans was recognized early on [14]; however, little is understood regarding the online research-seeking behavior of underrepresented populations within the United States. Frameworks generated from the field of internet technology adoption could be extrapolated to better understand the development of utilizing matching tools to increase participation in clinical trials [15]. The development of matching tools was broadly based on the technology acceptance model which proposes that the perceived usefulness and the perceived ease-of-use of the new technology are essential elements for its adoption [16]. These two elements were essential in the development of this internet-based matching tool intervention.

To address these issues of inadequate recruitment efforts of diverse patients in clinical trials, we evaluated the feasibility (tested in a limited way) [14], acceptability (by the intended audience) [14], and initial measures of efficacy of an English and Spanish, multilevel recruitment intervention. This pilot study was conducted at the University of California San Francisco (UCSF) Helen Diller Family Comprehensive Cancer Center (HDFCCC), using prostate cancer clinical trials. We hypothesized that pairing a matching tool with personalized navigator services to assist patients through trial selection and enrollment was likely to enhance participation [12,17], as navigator services embedded in cancer care have had positive effects on clinical trial recruitment [15,18]. Thus, in addition to a low-literacy, bilingual (English and Spanish) Internet-based clinical trial matching tool, we included a bilingual nurse navigator to facilitate enrollment. To attract users, particularly minorities, to this the matching tool, we initiated a broad community-based Internet advertising campaign.

2. Materials and methods

2.1. Study setting

The study was conducted between October 1, 2014 and April 15, 2015. The Spanish version of the matching tool was initiated on March 1, 2015 and was maintained until the end of the study. The Internet-based matching tool was available to anyone with Internet access, using standard search engines, or by the user selecting an advertisement on prostate cancer-related UCSF websites. The active Google AdWords advertising campaign (described below) was geographically targeted to the San Francisco Bay Area, with a particular focus on areas and neighborhoods with higher proportions of Latino and African American residents based on census data. The study was approved by the UCSF Institutional Review Board.

2.2. Description of intervention

The intervention consisted of three components: 1) a low-literacy, bilingual (English and Spanish), automated, Internet-based clinical trial matching tool; 2) a bilingual nurse who assisted interested individuals with questions and facilitated enrollment into clinical trials; and 3) a broad community-based Internet advertising campaign.

2.2.1. Internet-based clinical trial matching tool

The Internet-based clinical trial matching tool used in this study, which was hosted on a UCSF-supported website, was designed to be accessible to patients with limited health literacy and to present the fewest barriers to participation. The matching tool, which was embedded in the HDFCCC homepage, did not require registration, was offered in English and Spanish, asked the minimum number of questions needed to match participants to trials, and was programmed to offer only those trials tailored to the patient's personal prostate cancer characteristics. The tool's website and algorithm were built using the Qualtrics Research Suite, a HIPAA-compliant cloud-based survey program. Individuals arrived to the matching tool by clicking on either the link embedded in the HDFCCC website, searching for clinical trials using any internet search engine, clicking on our study's advertisement (when the Google AdWords advertising campaigns were active), or from other sources (e.g., word of mouth, etc.). At any given point during the study period, there were 17 interventional clinical trials for patients with various stages of prostate cancer open for accrual at UCSF.

Patients using the Internet-based matching tool, or family members or friends using the tool on the patient's behalf, were asked to complete a brief assessment to determine the patient's eligibility for the available clinical trials. To further maximize inclusion, in addition to applying a registration-free platform, we utilized only a small number of the most relevant screening questions. Considering our goal of serving low health literacy participants, we anticipated that not all respondents would have complete information about the patient's disease characteristics or medical history. Thus, we were concerned that using an “inclusion-only” algorithm (that is, individuals must fit all criteria that a specific clinical trial requires) would inadvertently screen out otherwise appropriate participants from clinical trials. Instead, we used a “non-exclusion” algorithm, whereby participants were deemed as “possibly matched” to a trial unless they specifically reported clinical information that would make them ineligible. To maximize the chances of including all patients who were potentially eligible for a trial, we asked about broad health criteria rather than more specific disease characteristics.

The matching algorithm used all available clinical data from the participant to match them to active trials at UCSF and displayed summaries of each trial to which an individual had been matched. All summaries were written at a sixth-grade reading level in both Spanish and English and presented in a clear, simple format. To minimize confusion, each summary was displayed on a separate page. Both general information and trial-specific details about eligibility, benefits, risks, and procedures were included. After each summary, participants were asked whether they were interested in the trial. Users who indicated interest in any matched trial were given an opportunity to submit their name, phone number, and other contact information. If contact information was submitted, an automated email containing the

relevant user information (contact information, clinical data, possible matches, interest indicated) was sent to the nurse navigator. Users for whom no match was found were informed of their ineligibility for any current trials and presented with links to other UCSF and National Cancer Institute resources. Patients or their family members who requested information were given a telephone number or an email where they could send a request.

2.2.2. Bilingual nurse navigator

An oncology nurse, bilingual in Spanish and English, was assigned to respond to phone and email requests from users of the matching tool. The nurse responded to participants based on their answers to the screening items, including information on the participant's diagnosis and health characteristics, knowledge of clinical trials, and potential barriers to participation. The nurse further assessed and confirmed eligibility for specific trials, provided additional verbal and/or written information about trials, and facilitated recruitment visits with appropriate clinical trial investigators. For this study, the nurse's role was solely to provide information to facilitate the participants' personal decision-making. The nurse navigator was not a member of any study team associated with specific clinical trials.

2.2.3. Internet-based advertising campaign

To increase community participation in prostate cancer clinical trials, and especially the participation of minorities, an Internet-based advertising campaign targeting the greater San Francisco Bay Area was developed. The advertising campaign was launched using Google AdWords, a fee-based service. AdWords bypasses Google's PageRank search result algorithm by displaying a specific advertisement (“ad”) link among search results to the right of the page when an individual enters predetermined keywords into a Google search query (e.g., prostate clinical trial). By clicking on a study ad, the user was directed to the matching tool site. AdWords can geographically target ads, with some precision, based on the Internet Protocol (IP) address of the user's device, which in turn is based on specific zip codes or a custom radius around arbitrary geographical coordinates. For mobile devices, Global Positioning Service (GPS) and cell towers are used to determine the current geographical location of the device, triggering ads relevant to that location. For this study, ads were targeted to the San Francisco Bay Area and specifically to those areas with a larger proportion of African-American, Latino, and Asian-American residents. The ads were run for three separate periods: October 28, 2014 to November 3, 2014 (one-week test), January 21, 2015 to February 12, 2015 (three weeks and 2 days), and March 12, 2015 to April 6, 2015 (three weeks and 5 days). Within all three periods, ads were run in English; Spanish ads ran only during the last period. The ads automatically took the user to the matching tool in the same language as the ad. The ads contained s brief description of the clinical trial matching tool. Using various keywords and groups of ads, AdWords allowed us to closely monitor the performance of individual ads and keywords (i.e., which ads or keywords were more likely to result in a site visit). Ineffective ads and keywords were eliminated in favor of better performing ones [19].

2.3. Measures

2.3.1. Demographic indicators

We collected demographic information about each person who used the matching tool: whether the user currently had prostate cancer or was a friend or family member of someone who was diagnosed with prostate cancer; age (categorized as ≤ 39, 40–75 years, 76–85, > 85); self-reported race/ethnicity (non-Latino white, Latino, African American, Asian or Pacific Islander, or American Indian and other groups); education level (high school/GED or less, some college or associate degree, bachelor's degree, or graduate education, and current or past utilization of UCSF medical center as a cancer care provider.

2.3.2. Health literacy

Health literacy was assessed with using three validated questions to determine the following: (1) the frequency with which the patient required a family member, friend, hospital worker, or caregiver to help read hospital materials; (2) the patient's concerns regarding a lack of understanding of his own medical condition due to difficulty understanding written information; and (3) the patient's level of discomfort with filling out medical forms alone [20,21]. Response categories for each item ranged from always (1) to never (5). We dichotomized responses to “always/often/sometimes” versus “rarely/never.”

2.3.3. Health indicators

The following prostate cancer-related indicators were included in the analysis: time since diagnosis (≤ 6 months, > 6 months, or not sure); PSA level at diagnosis (< 10 ng/ml, ≥ 10 ng/ml, or not sure); current PSA level status (increasing versus decreasing, or not sure); Gleason score (6, 7, ≥ 8, or not sure); whether or not the cancer had spread (metastasized to lung, liver, bone, and/or brain; cancer has not metastasized; not sure); prior prostate cancer treatments if any (prostate surgery, internal or external radiation therapy, hormone therapy injections, hormone therapy pills, chemotherapy, or cryosurgery).

2.3.4. Outcome indicators

The feasibility of this study was assessed with several outcomes: 1) completion of the matching tool, 2) expression of interest in a clinical trial by providing contact information, and 3) matching to a clinical trial. The effect of the Internet-based advertising campaign on the use of the matching tool was also evaluated. Potential impact of the intervention was assessed among those participants who provided contact information via follow-up qualitative interviews. We assessed discussion of risks and benefits of clinical trial participation with a physician and subsequent clinical trial participation. These patients were called once a week until contacted or until three attempts had been made without response. For patients who received medical care at UCSF, we assessed whether they participated in a clinical trial. We assessed the acceptability of the study by examining participants' feedback. We inquired about participants' thoughts about the matching program, including whether (a) the site was easy to use, (b) the matching results were useful, and (c) the information was easy to understand. Response options included “yes,” “somewhat,” and “no.”

2.4. Statistical analysis

Descriptive statistics were used to characterize users who were identified as having a prostate cancer diagnosis. Among participants with prostate cancer, bivariate analyses compared demographic and clinical characteristics of those who matched to at least one clinical trial compared to those who did not. Among those who matched to a clinical trial, we compared those who provided contact information versus those who did not. In addition, we compared the demographic characteristics of those who completed the tool during the Google AdWords campaign versus those who completed the tool outside the ad campaign period. Chi-square tests were carried out to assess any significant differences between categorical variables, and t-tests were used to assess differences in continuous variables (two-tailed significance level $p < 0.05$).

3. Results

3.1. Characteristics of participants

During the 28-week study period, 523 of those who responded completed at least some demographic information. Of these, 263 (50.2%) identified themselves as having prostate cancer (Table 1). Approximately two-thirds (64.6%) of participants with prostate cancer answered the questions for themselves, whereas over a third (35.4%)

Table 1
Characteristics of participants who identified with prostate cancer.

	Identified with Prostate Cancer	Matched V. Not Matched to a Trial			Contact Information among Matched Participants		
		No Match	Matched	P Value	Did Not Provide Information	Provided Information	P Value
	N = 263	N = 71 27%	N = 192 73%		N = 163 84.9%	N = 29 15.1%	
	%	%	%		%	%	
Individual Completing Matching Tool Survey							
Self	64.6	49.3	30.2	< 0.01	68.7	75.9	ns
Someone else	35.4	50.7	69.8		31.3	24.1	
If someone else, family member or friend	72.0	100	82.8	0.01	80.4	100	ns
Age							
≤39 years	0.8	1.4	0.5	ns	0.6	0	ns
40–75 years	84.4	84.5	84.4		83.4	89.6	
76–85 years	11.8	14.1	10.9		11.7	6.9	
> 85 years	3.0	0.0	4.2		4.3	3.5	
Ethnicity							
Non-Latino white	75.7	69.0	78.1	0.05	77.9	79.2	ns
Latino	6.8	14.1	4.2		4.3	3.5	
African American	4.2	2.8	4.7		3.7	10.3	
Asian or Pacific Islander	10.6	9.9	10.9		12.3	3.5	
American Indian and other groups	2.7	4.2	2.1		1.8	3.5	
Education							
High school/GED	10.3	13.0	9.5	ns	10.0	6.9	ns
Some college or AA	19.8	27.5	17.5		15.6	27.6	
Bachelor's degree	26.6	20.3	29.6		28.7	34.5	
Graduate education	41.4	39.1	43.4		45.6	31.0	
Missing	1.9	–	–		–	–	
Health Literacy (always, often, sometimes)							
Needs help reading materials	24.0	42.4	18.5	< 0.0001	18.1	20.7	ns
Difficulty understanding written materials	32.0	42.4	27.0	< 0.05	26.9	27.6	ns
Not comfortable filling out medical forms	16.9	25.8	13.8	< 0.05	12.5	20.7	ns
UCSF Patient							
No	67.6	58.2	73.2	ns	71.4	82.8	ns
No, but I have been one	16.0	20.9	12.1		13.0	6.9	
Yes	14.1	20.9	14.7		15.5	10.3	
Missing	2.3	–	–		–	–	

were doing so on behalf of someone with the disease. Most (84.4%) were between the ages of 40 and 75 years old. More than three-quarters (75.7%) of these participants identified as non-Latino white, 10.6% as Asian American, 6.8% as Latino, and 4.2% as African American.

The number of Latino respondents with prostate cancer who used the matching tool increased considerably once the Spanish-language version of the tool was launched. During a 21 ½-week period when the matching tool was available only in English, 5 (3.3%) respondents identified as Latino compared to the 13 (5.3%) respondents in the 6 ½-week period after making the tool available in Spanish.

Less than a third (30.1%) of participants reported having less than a bachelor's degree. A quarter (24.0%) of participants reported needing help reading materials given to them by a doctor or hospital, 32.0% reported they had at least some difficulty understanding written materials regarding their medical condition, and 16.9% reported not being comfortable filling out medical forms by themselves.

As for clinical characteristics, more than a third (36.1%) of the participants with prostate cancer received the diagnosis within the past six months, 36.1% reported a PSA score of ≥10 ng/mL, and 56.7% noted their PSA score was climbing (Table 2). Over a third (35.4%) of the participants reported a Gleason Score ≥ 8, and 31.2% indicated their cancer had not metastasized. Among those who reported prior treatment, 19.2% reported undergoing prostate surgery, 25.1% radiation therapy, 33.9% hormone therapy injections, 23.0% hormone therapy pills, 13.5% chemotherapy, and 1.5% cryosurgery.

3.2. Matching to trials

There were 17 prostate cancer clinical trials available over the course of the study for participants to be matched to during the study period (between 8 and 12 trials were open at any given point during the study), and 73% of men with prostate cancer matched to at least one of these trials. Among those who matched to a clinical trial (n = 192), nearly three-quarters (73%) matched to at least one trial and the median number of matched trials was 3, with a mean of 3.5 (SD = 2.2; range 1–10). Among the 29 men with prostate cancer who provided contact information (15.1%), the median number of trials was 3, with a mean of 3.4 (SD = 2.1; range 1–7).

3.2.1. Participants who matched to a clinical trial

Participants who matched to a clinical trial were significantly less likely to report for themselves, (30.2% versus 49.3% $p < 0.01$) and more likely to be white (78.1 versus 69.0 $p < 0.05$) compared to those who did not match to a trial (Table 1). In addition, those who matched were less likely to need help reading materials (18.5% versus 42.4% $p < 0.0001$), to have difficulty understanding written materials (27.0% versus 42.4% $p < 0.05$), and to feel uncomfortable filling out medical forms (13.8% versus 25.8%, $p < 0.05$).

There were also several significant clinical differences between the men who matched to at least one clinical trial and those who did not match (Table 2). Men who matched were significantly more likely to be diagnosed within six months of using the matching tool (42.7% versus

Table 2
Clinical characteristics of participants who identified with prostate cancer.

	Identified with Prostate Cancer	Matched V. Not Matched to a Trial			Contact Information among Matched Participants		
		N = 263			N = 192		
		No Match	Matched	P Value	Did Not Provide Information	Provided Information	P Value
	N = 263	N = 71 27%	N = 192 73%		N = 163 84.9%	N = 29 15.1%	
	%	%	%		%	%	
Time since Cancer Diagnosis							
6 months ago or less	36.1	21.3	42.7	< 0.0001	41.7	48.3	ns
More than 6 months ago	58.9	73.8	57.3		58.3	51.7	
Not sure	1.1	4.9	0.0		–	–	
Missing	3.8						
PSA Level at Diagnosis							
< 10 ng/mL	54.4	36.1	63.0	< 0.0001	66.3	44.8	ns
≥10 ng/mL	36.1	50.8	33.3		30.1	51.7	
Not sure	5.7	13.1	3.6		3.6	3.5	
Missing	3.8						
PSA Level Status							
Increasing	56.6	64.7	62.7	ns	63.1	60.7	ns
Decreasing	12.2	21.6	11.4		11.5	10.7	
Unchanged	12.2	7.8	15.1		14.6	17.9	
Not sure	8.7	5.9	10.8		10.8	10.7	
Missing	10.3	–	–		–	–	
Gleason Score							
6	14.7	3.6	19.4	< 0.0001	22.2	3.5	< **0.01**
7	22.1	10.9	27.2		23.5	48.3	
≥8	35.4	54.5	33.0		34.6	24.1	
Not sure	21.3	30.9	20.4		19.7	24.1	
Missing	6.5						
Cancer Spread							
No metastases	31.2	7.0	40.1	< 0.0001	42.9	24.1	ns
Metastasis	68.8	93.0	59.9		57.1	75.9	
Prior Prostate Cancer Treatment							
Prostate surgery	19.2	17.1	19.9	ns	19.1	24.1	ns
Radiation therapy	25.1	31.0	22.9	ns	22.1	27.6	ns
Hormone therapy injections	33.9	53.6	26.5	< 0.0001	24.4	37.9	ns
Hormone therapy pills	23.0	48.6	13.4	< 0.0001	12.7	17.2	ns
Chemotherapy	13.5	40.6	3.7	< 0.0001	3.7	3.4	ns
Cryosurgery	1.5	0.0	2.1	ns	1.9	3.4	ns

21.3%, $p < 0.0001$), to have PSA levels lower than 10 ng/mL (63.0% versus 36.1%, $p < 0.0001$), and to report no metastasis (40.1% versus 7.0%, $p < 0.0001$). They also were less likely to report hormone therapy injections (26.5% versus 53.6%, $p < 0.0001$), hormone therapy pills (13.4% versus 48.6%, $p < 0.0001$), and receipt of chemotherapy (3.7% versus 40.6%, $p < 0.0001$).

3.2.2. Participants who provided contact information

Among men who matched to at least one trial, men who provided contact information were not significantly different from those who did not provide information with one exception: Men who left contact information were less likely to report higher Gleason scores (≥8) than those who matched to a clinical trial (51.8 versus 45.7, $p < 0.01$).

3.3. Reach of Google AdWords

Fig. 1 shows the effect of the Internet ad campaigns on matching tool usage. The ad campaign was active in three separate phases for 7 of the 28 total weeks of the pilot study. Overall, the campaign increased the number of individuals with prostate cancer who completed the matching tool and who provided contact information. Over half of the participants reaching the study came via clicking on a Google AdWords ad (60.1% versus 39.9%), despite the ads running for less than 25% of the study time period. The average number of matching tool completions per week was 1.1 during weeks when the ads were not running compared to 9.0 per week when the ads were active. The number of people interested in clinical trial participation, measured by those who left contact information, increased as well. During weeks when ads were running, on average, 1.17 participants per week provided contact information compared to 0.07 participants per week when ads were not running.

The study spent approximately $500 per week when ads were running. The most used keywords were prostate cancer clinical trials, prostate, clinical trials, prostate cancer treatment, and prostate tumor. Comparison of demographic characteristics between those who responded during Google AdWords period and those who responded outside the ad periods indicates that there were no significant differences between the two groups with one exception: Those who answered the ads were more likely to have experienced prostate cancer themselves (Table 3).

3.4. Contact, follow-up interviews, and participation in clinical trials

Twenty-nine participants provided their contact information, three of whom died sometime between their use of the tool and our attempts to contact them for a follow-up interview. We completed 14 follow-up interviews (48.3% response rate). Based on the interview data, it was determined that 12 of 14 (85.7%) interview participants discussed the risks and benefits of enrolling in a clinical trial either with their primary care physician or a UCSF oncologist. Five men enrolled in a clinical trial, three of whom did so at UCSF. This represents a 35.7% participation rate in all trials regardless of location (5/14) and a 21.4% participation rate in UCSF clinical trials (3/14) among those who completed follow-up interviews. Reasons reported for not enrolling at UCSF

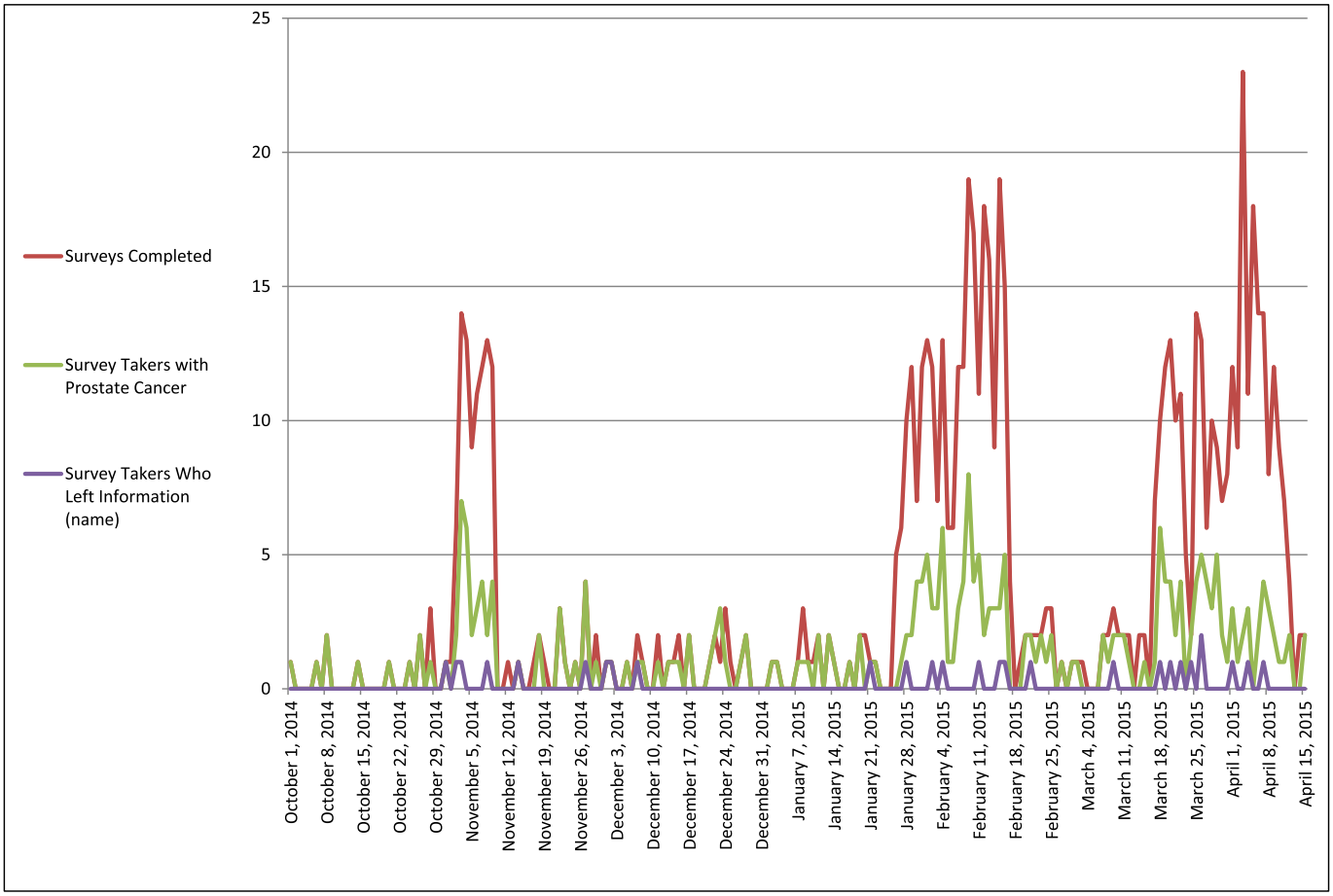

Fig. 1. Survey completion, survey participants with prostate cancer, and survey participants who left information.

included limitations imposed by third party insurance, travel distance, and lack of information and/or contact from UCSF personnel. Enrollment in a trial somewhere other than UCSF by men who did not make an appointment at UCSF or who were not reached by telephone or e-mail for a follow-up interview could not be determined.

3.5. Feedback on the matching program

Forty-nine participants provided feedback on the Internet-based clinical trial matching tool. Of those, almost all (98%) reported the site was easy to use. Three-quarters (74.5%) found the matching results useful, while 19.1% found them somewhat useful. Almost all the respondents (97.9%) reported that the information provided was easy to understand.

4. Discussion

This pilot study provided evidence that an automated, Internet-based clinical trial matching tool with targeted Internet-based advertising is feasible, acceptable, and effective in reaching men with prostate cancer. In addition, this study demonstrated that geographic targeting and the use of Spanish-language matching tool and advertisements increased the proportion of Latino participants. These findings are supported by similar studies examining Internet matching tools [22]. However, our study population was 25% non-white compared to 10% in similar matching studies and was able to reach a higher proportion of minority populations [22]. Spratt and colleagues reported that African American men comprise about 3.3% of phase III randomized clinical trials in prostate cancer [23]. Our study found that 5.1% of participants who used the matching tool when the Google AdWords campaign was live identified as African American. The targeted geographical areas and diversity of the Northern California population, as well as the effort to target the Latino population, may account for these discrepancies.

This approach was relatively easy to implement, leveraging available off-the-shelf technology. A widely used Qualtrics survey platform was employed to construct a simple website, which included a matching tool algorithm that required minimal upkeep. The feasibility and applicability of this model is reflected, in part, by the resource efficiency of the program. Although initial efforts are required to design the questionnaire, program the Internet-based tool, and prepare the trial summaries provided to participants, maintenance further along is required only as trials open and close.

The matching tool was designed to reduce participant burden while broadening their options. This approach matched participants to trials fitting their specific clinical situation. This is different from other algorithms that only roughly match a participant's condition to a clinical trial. For example, traditional matching to the extent of disease (e.g., metastatic prostate cancer) critically misses hormonal status (sensitive or resistant), which is an equally important determinant of trial eligibility. Conversely, this tool avoided overemphasis on granular clinical details to eliminate a potential source of participant frustration and to minimize risk of inaccurate responses, limiting the relevance of participant-trial matches. This approach generated a broad yet relevant list of trials for each participant, allowing for a greater choice and more information regarding potential trials. Additionally, participants who used the matching tool found it easy to navigate and did not identify complexity of the language nor the amount or length of questions as barriers to participation.

This approach is among the first to implement Spanish-language

Table 3
Participants' characteristics during and outside of Google Ad periods.

	N = 263		
	Outside of Google Ad Period	During Google Ad Period	P Value
	N = 105 39.9%	N = 158 60.1%	
	%	%	
Individual Completing Matching Tool Survey			
Self	57.1	69.6	< 0.05
Someone else	42.9	30.4	
If someone else, family member or friend	88.6	89.6	ns
Age			
≤39 years	0.0	1.3	ns
40–75 years	88.6	81.6	
76–85 years	11.4	12.0	
> 85 years	0.0	5.1	
Ethnicity			
Non-Latino white	77.1	74.6	ns
Latino	6.6	7.0	
African American	2.9	5.1	
Asian or Pacific Islander	12.4	9.5	
American Indian and other groups	1.0	3.8	
Education			
High school/GED or less	7.8	12.2	ns
Some college or AA	17.6	21.8	
Bachelor's degree	22.5	30.1	
Graduate education	52.0	35.9	
Health Literacy (always, often, sometimes)			
Needs help reading materials	26.0	23.8	ns
Difficulty understanding written materials	30.8	31.1	ns
Not comfortable filling out medical forms	13.5	19.2	ns
UCSF Patient			
No	63.1	73.4	ns
No, but I have been one	19.4	14.3	
Yes	17.5	12.3	

support along with IP-address targeted advertising in an effort to increase clinical trial access among underrepresented minorities. When Spanish-language version was run, the proportion of Latino respondents more than tripled, from 9% to 30%. When implemented at scale and over a longer duration, such interventions may help to better balance demographic representation among trial participants. While prostate cancer clinical trials continue to underrepresent racial/ethnic minorities [23], these findings suggest that underrepresented minorities are actively seeking online health information. Therefore, this study serves as an important rationale for future investigators to develop novel Internet-based interventions to deliver health information to a diverse population of men with prostate cancer. The approach applied in this study can be translated into other social media platforms with advertisements, such as Facebook and Twitter. Future interventions can continue to target advertisements to geographical areas where minorities or Spanish speakers reside in an effort to reduce the overall cost of recruitment.

There are a number of limitations to this study; most reflect the fact that this was a pilot feasibility study. First, only a small proportion of the Internet-based tool users enrolled in a trial during the study period. The decision to participate in a cancer clinical trial is complex, and assessing eligibility is just a starting point. There are a number of patient and physician contextual attributes that inform the decision to proceed with trial enrollment. The decision to participate in trials is an ongoing process, one in which potential participants establish care through a cancer center active in clinical research and with ongoing evaluation and discussion thereafter. While this pilot study obtained only preliminary estimates of efficacy on enrollment, a large number of person-to-person contacts and in-office visits occurred due to the matching tool. These users otherwise may never have made contact with a cancer research center; therefore, increased enrollment downstream may not be captured fully. Due to the complexity of clinical trial accrual, this feasibility study was not designed to ultimately measure the impact of this intervention on increasing accruals to clinical trials.

Second, although there appeared to be a significant impact of Spanish-language matching tool and advertising, a formal comparison of advertising with and without Spanish-language advertisements was not undertaken. The increase in the proportion of Latino respondents was based on a relatively small sample size, during a relatively short time period of advertising in Spanish.

Finally, when the pilot was launched, the time requirement of the bilingual patient navigator was not known, and in retrospect, it is clear that insufficient effort was budgeted to this project. Although many participants accessed the Internet-based clinical trial matching tool, human-to-human contact remained the key component in the generation of dialogue, including meaningful in-office visits to discuss clinical trial enrollment. Our post-participation interviews revealed that lack of person-to-person outreach on behalf of the cancer program was the main reason for failure to establish a visit and/or trial enrollment. Conversely, all patients who scheduled visits at our center, including those ultimately enrolling in trials, reported prompt contact by phone or email on behalf of study personnel as their main conduit towards visitation and enrollment. Consequently, the results reported may be skewed by this rate-limiting step.

5. Conclusions

In summary, this pilot program has shown that a personalized, questionnaire-based online approach (i.e., the matching tool), can improve access and potentially facilitate enrollment among individuals who otherwise may not participate in clinical trials. Both the ease of use and the broad reach of the Internet-based tool, and therefore the potential recruitment strength of this program, are reflected in the number of total users who completed the matching tool. Ultimately, this program served as an additional avenue through which patients, especially those who may not have considered a clinical trial as a viable option, were able to access trial participation. Today, online health information resources for a diverse population of men with prostate cancer are limited. While caution for the digital divide may have exacerbated disparities in health information resources, this study highlights the acute need for and investment in more robust Internet health information infrastructure. Future studies will need to deliver more comprehensive online resources for a diverse population of men with prostate cancer.

Conflict of interest disclosure

The authors have no conflicts of interest to disclose.

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The funding sources had no role in the study design; the collection, analysis, or interpretation of data; the writing of the report; or the decision to submit the article for publication.

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