Improving the Efficiency of HIV Testing With Peer Recruitment, Financial Incentives, and the Involvement of Persons Living With HIV Infection

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Background: The authors piloted an HIV testing and counseling (HTC) approach using respondent-driven sampling (RDS), financial incentives, and persons living with HIV infection (PLHIV).

Methods: Eligible participants were aged 30–60 years, African American or black, and residents of Oakland, CA. Participants were tested for HIV infection and asked to refer up to 3 others. The authors compared the efficiency of RDS to conventional outreach-based HTC with the number needed to screen (NNS). They evaluated the effect of 2 randomly allocated recruitment incentives on the enrollment of high-risk or HIV-positive network associates: a flat incentive ($20) for eligible recruits or a conditional incentive ($10–35) for eligible recruits in priority groups, such as first-time testers.

Results: Forty-eight participants (10 PLHIV and 38 HIV negative) initiated recruitment chains resulting in 243 network associates. Nine (3.7%) participants tested HIV positive, of whom 7 (78%) were previously recognized. RDS was more efficient than conventional HTC at identifying any PLHIV (new or previously recognized; RDS: NNS = 27, 95% CI: 14 to 59; conventional: NNS = 154, 95% CI: 95 to 270). There was no difference between the 2 incentive groups in the likelihood of recruiting at least 1 high-risk HIV-negative or HIV-positive network associate (adjusted odds ratio = 0.89, 95% CI: 0.06 to 13.06) or in total number of high-risk HIV-negative or HIV-positive associates (adjusted odds ratio = 0.79, 95% CI: 0.23 to 2.71).

Conclusions: Social network HTC strategies may increase demand for HTC and efficiently identify PLHIV. The flat incentive was as successful as the conditional incentive for recruiting high-risk individuals. Unexpectedly, this method also reidentified PLHIV aware of their status.

Key Words: HIV testing, respondent-driven sampling, incentives, efficiency

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INTRODUCTION

HIV testing and counseling (HTC) is the gateway to both prevention and care services; however, approximately 20% of the 1.2 million people living with HIV infection (PLHIV) in the United Status are unaware of their status.[1] In addition, an estimated 32% of people diagnosed with HIV in 2009 received an AIDS diagnosis simultaneously or within 1 year of their first positive test (late diagnosis).[2] Besides forgoing the clinical benefits of early treatment and care, persons with undiagnosed infection may unknowingly transmit HIV to partners, especially before initiation of antiretroviral therapy.[3–5] Poor HTC uptake also undermines promising prevention strategies including preexposure prophylaxis.[6] Thus, increasing the number of PLHIV who are aware of their serostatus is a benchmark of the National AIDS Strategy.[7]

In 2006, the Centers for Disease Control and Prevention (CDC) issued revised recommendations for the adoption of routine, voluntary HIV screening in all health care settings.[8] The new guidelines shifted away from the unsuccessful targeted testing strategies of the past and were intended to increase the number of people tested, de-stigmatize the testing process, and improve linkage to care.[8] However, the efficiency of universal screening programs is unclear,[9] especially in settings such as emergency departments where there are numerous implementation challenges and the prevalence of HIV infection is typically $<1\%$.[10–12] Thus, the need for efficient and nonstigmatizing strategies to increase uptake of HTC remains critical, especially among highly affected populations.

Over the past decade, 2 variations of client-initiated HTC have emerged with the potential to increase the efficiency of HIV testing without resorting to race- or risk-based targeting. The first approach uses social networks (eg, respondent driven sampling [RDS] or peer recruitment), asking participants to serve as temporary recruiters to refer members of their social

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network for HTC. Such approaches may be an efficient way to access individuals at high risk for HIV infection who may be "hidden" because they engage in illegal or stigmatizing behaviors.[13–20] Although these methods are often used to find injecting drug users or sex workers, there is growing interest in their use in the general population. Social network strategies have been shown to increase demand for HTC and identify a higher proportion of newly identified PLHIV compared with conventional methods, especially when PLHIV are recruiters.[15,17,21]

Financial incentives constitute a second promising and innovative approach to promote client-initiated HTC. Behavioral economic theory suggests that individuals often have "present-biased preferences," placing disproportionate weight on the present while heavily discounting the future.[22,23] An implication is that, when a behavior has immediate costs and delayed benefits, information alone may be inadequate to change behavior. Such is the case with HTC: there are immediate *logistical* costs (eg, transport and time) and *psychological* costs (eg, fear and stigma) whereas benefits (eg, treatment and survival) are delayed. The use of financial incentives adds an immediate benefit to counteract present costs and may, therefore, effectively change behavior. A growing body of experimental evidence has demonstrated that small cash incentives can increase HTC uptake.[24,25]

We piloted a community-based HTC strategy in Oakland, CA, that combined peer recruitment (with a strong focus on PLHIV) and financial incentives. The study targeted African Americans, who are disproportionately affected by the HIV/AIDS epidemic and who represented 46% of all late diagnoses in Alameda County (where Oakland is located) from 2006 to 2010 (N. Murgai, personal communication, Alameda County Public Health Department Surveillance Data, Late Diagnosis of HIV Infection, 2006-2010, Oakland, CA, 2012).[26,27] Our goals were to create demand for HTC, to compare the efficiency of this approach to standard HTC, and to assess the feasibility and effectiveness of 2 incentive schemes within the RDS framework to increase the efficiency of identifying people at risk of HIV infection. The following hypotheses guided the research: (1) RDS recruitment is at least as efficient in identifying PLHIV as conventional HTC methods; (2) financial incentives conditional on recruiting higher-risk individuals are more effective than fixed incentives for identifying PLHIV and high-risk individuals; and (3) networks initiated by PLHIV (irrespective of incentive) contain more high-risk or HIV-positive individuals than networks initiated by HIV-negative individuals.

METHODS

Between March 2011 and February 2012, we evaluated a RDS pilot project with financial incentives to increase HTC among African American adults. RDS is a chain referral method where initial participants (seeds) recruit others for the study.[28] Those individuals, in turn, refer other individuals in successive waves of participant recruitment. Financial incentives, for study participation and recruiting, help to motivate recruitment efforts.

Study Population

The study was implemented at 4 community agencies that offer client-initiated HTC at storefront offices and in mobile units. Eligible study participants were African American or black, 30–60 years old (inclusive; the population more likely to receive a late diagnosis[29]), Oakland residents, of unknown HIV status (except PLHIV seeds who initiated some recruitment chains), willing to be tested for HIV infection, and willing and able to provide written informed consent.

Study Design

Each agency recruited an initial group of 8–12 HIV-negative and HIV-positive participant seeds who were given 3 referral coupons to initiate recruitment chains. Coupons offered a free HIV test, listed study site locations and hours, and included some information about the study. Presentation of the coupon by subsequent recruits (network associates) was required, as it included a numeric tracking code that linked recruiters to recruits. Eligible network associates who enrolled in the study were also given 3 referral coupons; recruitment waves continued for 1 year (Fig. 1). After HTC, participants were interviewed by test counselors about sociodemographics, risk behavior, and network characteristics. All participants (seeds and network associates) were told that they did not have to disclose their serostatus when recruiting others. We compared the efficiency of the RDS approach to conventional client-initiated HTC during the same time period.

Randomization and Incentive Schemes

In RDS, participants are compensated for study participation (testing incentive) and for recruiting others who enroll in the study (recruitment incentive).[16,17,20] In this study, we compared 2 different recruitment incentives as a modification to the standard RDS approach.

Testing Incentive

In Oakland, incentives for HTC are standard practice at many community agencies. We standardized the testing incentive at $10 (via a gift card to a local retailer).

Recruitment Incentive

Participants were randomly assigned to 1 of 2 incentive schemes. In one group, consistent with standard RDS practice, participants were compensated with a $20 gift card for each eligible recruit who enrolled in the study (flat incentive).[28] In the second group, participants received a $10 gift card for each eligible recruit who enrolled in the study plus additional additive payments conditional on recruitment of priority groups in need of linkages to services (conditional incentive): $5 for individuals who had never received services at the agency, $5 for injection drug users who had never been to a syringe exchange or used "roving exchanges," $10 for individuals who had never been tested for HIV infection or $5 for individuals who had not been tested in the last 12 months, and $5 for individuals released from prison in the last 12 months. The choice of priority groups for the conditional payments was intended to link new clients to prevention services, rather than targeting individuals' sexual and drug-using risk behaviors (which may be unknown to the recruiter).

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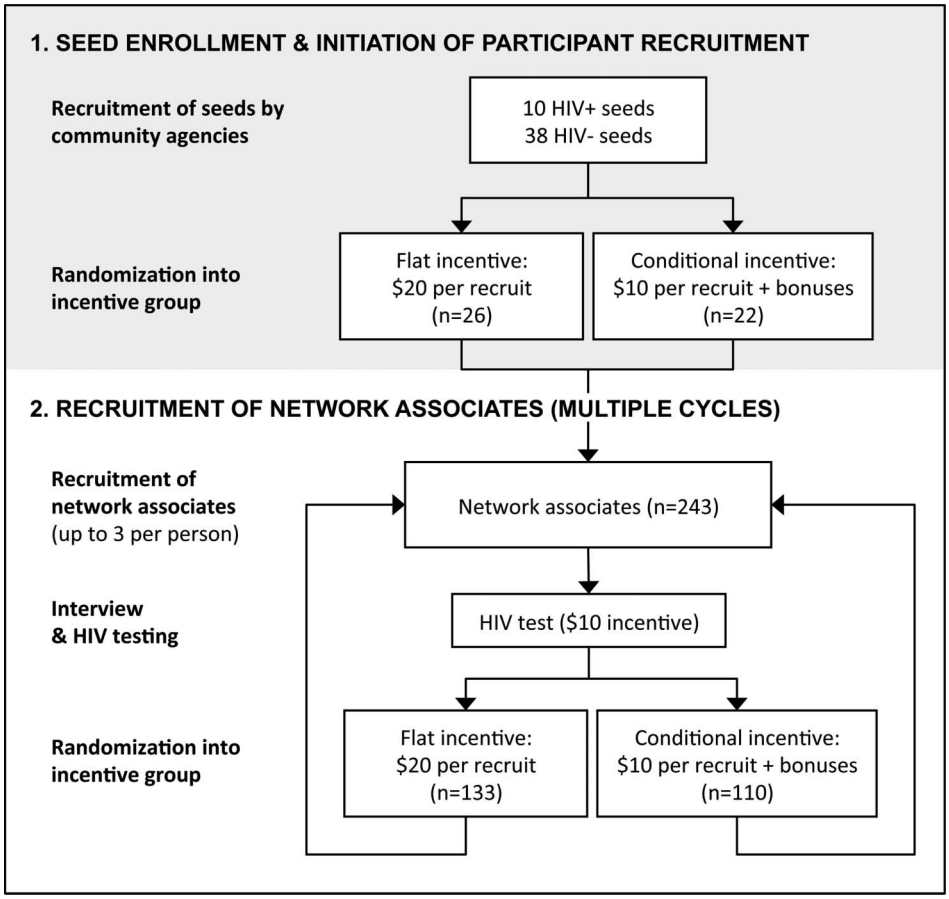

FIGURE 1. Flow diagram of participants in the study. Each participant could recruit up to 3 other participants (network associates) for the study.

Participants received a handout with recruiting tips, eligibility criteria, priority groups, and information about their incentive scheme. Both groups were encouraged to recruit individuals from the priority groups. Thus, we were able to examine whether the *conditional* payment for recruitment resulted in greater numbers of high-risk individuals and PLHIV compared with the flat payment. Incentive schemes were developed in consultation with community partners in combination with data from formative interviews and focus group discussions. Average incentive amounts were anticipated to be roughly equal in the 2 groups, although the *maximum* potential reward for recruiting was $60 in the flat incentive group versus $105 in the conditional incentive group.

Outcome Assessment

Participants were categorized as known HIV positive, newly diagnosed HIV positive, high-risk HIV negative, and low-risk HIV negative. Participants were tested for HIV infection with OraQuick *ADVANCE* Rapid HIV-1/2 Antibody Test (Orasure Technologies, Inc, Bethlehem, PA); those with a positive rapid test were referred for confirmatory testing and linked into care per each agency's protocol.

We matched preliminary positive network associates to the Alameda County Public Health Department's name-based enhanced HIV/AIDS Registry System (eHARS) and surveillance records to determine if any were previously identified, and if so, the date of the most recent contact with HIV/AIDS primary care. Participants were classified as "high risk" if, in the last 12 months, they engaged in *any* of the following activities: sex in exchange for drugs/money; injected drugs; engaged in sex with other men (males only), had sex with someone who injects drugs or is HIV positive; had unprotected sex with someone of unknown HIV status; had more than 1 sex partner; or was diagnosed with a sexually transmitted infection.[30]

Statistical Analysis

We first compared participant characteristics stratified by recruiter status (seed versus network associate). We compared the efficiency of the RDS approach to client-initiated HTC using the number needed to screen (NNS), defined here as the average number of network associates tested to identify 1 PLHIV (ie, the inverse of HIV prevalence).[31] For this analysis, seeds were excluded. To compute NNS for conventional client-initiated HTC, each agency recorded the total number and outcome of tests conducted during the same time period as the RDS study (agencies did not have access to eHARS to determine if individuals testing positive represented new or previously recognized diagnoses). We present NNS and 95% confidence intervals (CIs), computed as the inverse of the 95% exact binomial confidence limits of HIV prevalence.

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We evaluated the effect of the conditional versus flat recruitment incentive on (1) the number of recruits from priority groups and (2) the number of high-risk or HIV-positive recruits. We first compared participant characteristics in the 2 incentive groups using Pearson χ^2 test or Fisher exact test for categorical variables and Student *t* test for continuous variables. Then, for each participant, we computed the number of recruits in priority and high-risk/HIV-positive groups, ranging from 0 to 3 (the maximum number of recruits per person). To determine the effect of the incentive scheme on the number of recruits, we evaluated regression models using the Poisson, negative binomial, zero-inflated Poisson (ZIP), and zero-inflated negative binomial distributions (zero-inflated models are used for count data with excessive zeros, in this case, study participants with no recruits, 55% of the overall sample; 52% and 60% in the flat and conditional incentive groups, respectively). The ZIP regression model provided the best fit based on likelihood ratio tests of the dispersion parameters and the Vuong test.[32] In this model, the excess zeros are modeled independently as part of a binary (logistic) model and the Poisson distribution is used to model the count process. The combined ZIP model is then used to estimate both processes: whether a study participant had any recruits (associations from the logistic model are odds ratios), and for those who had recruits, how many recruits (associations from the Poisson model are interpreted as the ratio of the number of recruits for 2 covariate levels).

The unadjusted analysis included a binary indicator for randomization group and robust standard errors to account for clustering within network (all recruits originating from the same seed). The adjusted model also included agency, covariates not balanced after randomization, and covariates specified a priori for inclusion (ie, age, sex, risk level, and HIV serostatus).

We compared the composition of recruits in networks initiated by HIV-negative versus PLHIV seeds by comparing the proportion of high-risk HIV-negative or HIV-positive recruits in each network with a 2-sample *t* test after eliminating networks that had <5 people. Given that the study was a pilot to determine feasibility, we did not conduct formal power calculations. All analyses were conducted with Stata v.12 (StataCorp, College Station, TX).

Ethical Approval

The University of California, Berkeley, Committee for Protection of Human Subjects approved this study.

RESULTS

Participant Characteristics

Forty-eight participant seeds (10 PLHIV, 26 high-risk HIV-negative, and 12 low-risk HIV-negative) initiated recruitment chains. Seeds were predominantly men (67%), heterosexual (79%), had previously been tested for HIV infection (94%), and had a mean age of 45 years (range, 30–65 years, Table 1). Of the 48 seeds, 25 (52%) recruited at least 1 network associate; the median number of recruits was 1 (range, 0–3). Ultimately, 243 network associates were recruited in an average of 3.9 waves per seed (range, 1–12). Of the 243 network associates, 105 (43%) recruited at least 1 other person (median, 0; range, 0–3). Associates were similar to seeds, although they were more likely than seeds to have never received services at the community agency (81% versus 52%), to have never been tested for HIV infection (23% versus 8%), and to not have been tested in the last 12 months (94% versus 60%).

Overall, 9 (3.7%) network associates tested HIV positive. Of these, 7 were recorded in eHARS and not newly identified. Four (57%) of these 7 known PLHIV had no evidence of care in the 6 months before enrollment (median, 31 months); all were reconnected to care after the study.

Comparison of RDS Recruitment to Conventional Outreach-Based HTC at Identifying PLHIV

Using RDS, 27 people were screened for each person detected with HIV infection (NNS = 27 [243/9], 95% CI: 14 to 59). During the study period, 16 of the 2471 clients initiating HTC at the community agencies (not through the study) tested HIV positive (NNS = 154, 95% CI: 95 to 270). After exclusion of the 7 previously recognized PLHIV in the RDS study, NNS = 122 (95% CI: 34 to 1002).

Comparison of Flat Versus Conditional Recruitment Incentives

After randomization, participants in the 2 arms were similar except participants assigned to the conditional incentive arm were more likely to have had unprotected sex with someone of unknown HIV status in the last year (58% versus 39%, $P < 0.01$). Of the 243 network associates, 142 (58%) and 101 (42%) were recruited by recruiters in the flat and conditional payment arms, respectively (Table 2). Network associates were similar between recruiters in the 2 incentive arms and the number of high-risk and priority group network associates was extremely high overall (71% and 96%, respectively), largely driven by the numbers of people who reported unprotected sex with partners of unknown status, and those who were new agency clients. On average, participants earned $17.86 and $14.62 for recruiting in the flat and conditional payment arms, respectively ($P = 0.19$).

In unadjusted and adjusted analyses (Table 3), there was no difference between the incentive groups in the likelihood of recruiting at least 1 network associate who was a member of a priority group (adjusted odds ratio = 0.92, 95% CI: 0.27 to 3.13) or in the total number of priority group recruits (ratio comparing conditional incentives to flat incentive = 0.84, 95% CI: 0.45 to 1.58). Similarly, in unadjusted and adjusted analyses, there was no difference in the recruitment of high-risk HIV-negative or HIV-positive recruits (any or total number).

Comparison of PLHIV and HIV-Negative Recruiters

Thirteen (27%) seeds, including 3 PLHIV seeds, initiated networks that eventually contained ≥5 network associates. On average, 70 percent of the networks consisted of high-risk HIV negative or HIV-positive network associates (range: 46–100%).

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TABLE 1. Sociodemographic and Behavioral Characteristics of 291 African American or Black Study Participants in Oakland, CA; Stratified by Recruiting Status and Randomization Arm

	All participants	Recruiting Status*		Randomization Arm†		
Characteristic	N (%)	Seed N (%)	Network Associate N (%)	Flat Incentive N (%)	Conditional Incentive N (%)	P‡
Total	291 (100)	48 (16.5)	243 (83.5)	159 (54.6)	132 (45.4)	
Sex						
Male	186 (63.9)	32 (66.7)	154 (63.4)	101 (63.5)	85 (64.4)	0.88
Female	105 (36.1)	16 (33.3)	89 (36.6)	58 (36.5)	72 (35.6)	
Age (mean, range), yr	47 (30–65)	45 (30–65)	47 (30–60)	47 (30–65)	46 (30–60)	0.25
Sexual orientation						
Heterosexual	244 (83.9)	38 (79.2)	206 (84.8)	136 (85.5)	108 (81.8)	0.41
Gay/lesbian	18 (6.2)	6 (12.5)	12 (4.9)	7 (4.4)	11 (8.3)	
Bisexual	29 (9.9)	4 (8.3)	25 (10.3)	16 (10.1)	13 (9.9)	
Education						
Less than high school	73 (25.1)	13 (27.1)	60 (24.7)	45 (28.3)	28 (21.2)	0.36
High school graduate	108 (37.1)	11 (22.9)	97 (39.9)	57 (35.8)	51 (38.6)	
More than high school	109 (37.5)	24 (50.0)	85 (35.0)	56 (35.2)	53 (40.2)	
Income						
<$10,000/yr	216 (74.5)	37 (77.1)	179 (73.7)	118 (74.2)	98 (74.2)	0.67
$10,000–$29,000/yr	64 (22.1)	6 (12.5)	58 (23.9)	36 (22.6)	28 (21.2)	
≥$30,000/yr	10 (3.5)	5 (10.4)	5 (2.1)	4 (2.5)	6 (4.5)	
Homeless in last 12 months	112 (54.4)	21 (43.8)	91 (37.4)	63 (39.6)	49 (37.1)	0.53
Skipped a meal in last 12 months	149 (51.2)	25 (52.1)	124 (51.0)	81 (50.1)	68 (51.5)	0.97
High risk behavior in previous 12 mo						
MSM	28 (9.6)	6 (12.5)	22 (9.1)	13 (8.2)	15 (11.4)	0.36
Injected drugs	22 (7.6)	11 (22.9)	11 (4.5)	9 (5.7)	13 (9.8)	0.18
Sex in exchange for money/drugs	38 (13.1)	10 (20.8)	28 (11.5)	17 (10.7)	21 (26.6)	0.19
Sex with IDU	28 (9.6)	9 (18.8)	19 (26.6)	14 (8.8)	14 (10.6)	0.60
Sex with PLHIV	9 (3.1)	6 (12.5)	3 (1.2)	4 (2.5)	5 (3.8)	0.74
Unprotected sex with someone of unknown HIV status	138 (47.4)	17 (35.4)	121 (49.8)	62 (39.0)	76 (57.6)	<0.01
Sex with >1 partner	148 (51.6)	28 (58.3)	120 (49.4)	78 (49.1)	70 (53.0)	0.56
Diagnosed with STI	7 (2.4)	1 (2.1)	6 (2.5)	3 (1.9)	4 (3.0)	0.71
Any high risk behavior§	209 (71.8)	38 (79.2)	171 (70.4)	106 (66.7)	103 (78.0)	0.03
HIV serostatus‖						
Negative	272 (93.5)	38 (79.2)	234 (96.3)	150 (94.3)	122 (92.4)	0.82
Known HIV+ (seeds)¶	10 (3.4)	10 (20.8)	—	4 (2.5)	6 (4.5)	
Previously identified HIV+ (affiliates)	7 (2.4)	—	7 (2.9)	4 (2.5)	3 (2.3)	
Newly identified HIV+ (affiliates)	2 (0.7)	—	2 (0.8)	1 (0.6)	1 (0.8)	

*Initial participants (seeds) were selected to enroll in the study by community agencies. "Network associates" were recruited by members of their social network.
†Participants were randomized into either the flat or conditional incentive arm that determines the potential incentive earned for each eligible recruit who enrolls in the study.
‡Pearson χ^2 or Fisher exact test for categorical variables and Student t test for continuous variables. H_0, no difference between the two study arms.
§Reporting at least one of the higher risk behaviors in the last 12 months.
‖Preliminary positive HIV test results were verified with eHARS records at the Alameda County Public Health Department Office of AIDS Administration. Of the 9 network affiliates testing HIV positive, 7 (78%) were previously recognized and not newly identified.
¶Not tested as part of the study.
MSM, man who has sex with men; IDU, injection drug user; STI, sexually transmitted infection.

The proportion of network associates who were at high risk or HIV positive was nonsignificantly greater in networks initiated by PLHIV than networks initiated by HIV-negative participants (79% versus 67%, $P = 0.33$). None of the 9 associates who tested HIV positive recruited other participants.

DISCUSSION

HTC is the first step to access prevention services and is the entry point for treatment and care for PLHIV.[33] However, increasing demand for HTC and ensuring linkage to care remains a fundamental challenge in the United States.[4,34,35] In this study, we piloted an HTC approach among African American adults using RDS, variable financial incentives, and involvement of PLHIV. We found that this strategy was feasible in the community agency setting and was at least as efficient as conventional outreach methods at identifying newly diagnosed PLHIV and more efficient than conventional outreach methods at identifying any PLHIV. Other studies have also reported the superior efficiency of peer recruitment

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TABLE 2. Characteristics of 243 Network Associates Living in Oakland, CA, Stratified by the Recruiter's Randomization Arm

Characteristic of the Network Associates	All Network Associates, N (%)	Randomization Arm of Recruiter*		P†
		Flat Incentive, N (%)	Conditional Incentive, N (%)	
Total	243 (100)	142 (58.4)	101 (41.6)	
Priority group‡				
New agency client	196 (80.7)	111 (78.2)	85 (84.2)	0.24
IDU never been to needle or roving exchanges	5 (2.1)	2 (1.4)	3 (3.0)	1.00
Released from prison in last 12 months	23 (9.5)	15 (10.6)	8 (7.9)	0.70
HIV testing history				
Never been tested	56 (23.0)	35 (24.6)	21 (20.8)	0.78
Previously tested, >12 months	119 (49.0)	68 (47.9)	51 (50.5)	
Previously tested, ≤12 months	68 (28.0)	39 (27.5)	29 (28.7)	
Any priority group	232 (95.5)	136 (95.8)	96 (95.0)	0.77
High risk behavior in previous 12 months				
MSM	22 (9.1)	12 (8.5)	10 (9.9)	0.69
Injected drugs	11 (4.5)	5 (3.5)	6 (5.9)	0.45
Sex in exchange for money/drugs	28 (11.5)	15 (10.6)	13 (12.9)	0.55
Sex with someone who injects drugs	19 (7.8)	13 (9.2)	6 (5.9)	0.37
Sex with PLHIV	3 (1.2)	2 (1.4)	1 (1.0)	0.78
Unprotected sex with partner of unknown status	121 (49.8)	74 (52.1)	47 (46.5)	0.45
Sex with >1 partner	120 (49.4)	70 (49.3)	50 (49.5)	0.90
Diagnosed with STI	6 (2.5)	3 (2.1)	3 (3.0)	0.69
Any high risk category§	171 (70.4)	101 (71.1)	70 (69.3)	0.76
Any high risk category or HIV positive	172 (70.8)	102 (71.8)	70 (69.3)	0.67

*In the "flat incentive" scheme, participants were compensated with a $20 gift card for each eligible recruit who enrolls in the study. In the "conditional incentive" scheme, participants received a $10 gift card for each eligible recruit who enrolls in the study plus additional payments for priority groups.

†Pearson χ^2 test or Fisher exact test of the null hypothesis of no difference between the 2 study arms.

‡Priority groups were (1) individuals who had never received services at the community agency before; (2) injection drug users who had never been to a syringe exchange or used the roving exchanges; (3) individuals who had never been tested for HIV infection or not been tested in the last 12 months; and (4) individuals who were released from prison in the last 12 months.

§Participants were classified as high risk if, in the last 12 months, they engaged in any of the following activities: sex in exchange for drugs/money; injected drugs; was a man who had sex with other men (MSM); had sex with someone who injects drugs or is HIV positive; had unprotected sex with someone of unknown HIV status; had more than 1 sex partner; or was diagnosed with a sexually transmitted infection (STI).[30]

STI, sexually transmitted infection; MSM, men who have sex with men; IDU, injection drug user.

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strategies for HTC, including a CDC study in 9 cities in the United States.[17] However, the unexpected recruitment of PLHIV who were aware of their status, despite the study's focus on recruiting people of unknown serostatus, raises questions about the efficiency of social network strategies at detecting *newly diagnosed* PLHIV and highlights a research gap for future studies.

Repeat testing after an initial positive HIV test has been previously reported[36,37] and underscores the importance of verifying newly identified positive status with surveillance records. New York City's Department of Health and Mental Hygiene found that the prevalence of newly identified HIV cases from a community-based social network study dropped 37% (from 5.4% to 3.4%) after previously diagnosed individuals were excluded.[36] Furthermore, only 37% of New York City's 31,504 positive Western blots between 2004 and 2006 represented new diagnoses.[37] In the absence of eHARS verification, we would have erroneously categorized all 9 HIV-positive recruits as newly diagnosed and overstated the efficiency of our social network HTC approach at identifying newly diagnosed PLHIV. Indeed, the efficiency of our testing approach is dramatically different previously identified PLHIV are excluded (NNS = 27 versus NNS = 122). Unfortunately, we do not know how many of the PLHIV identified with conventional testing approaches were also previously identified; so, we do not have a comparable NNS estimate restricted to newly identified PLHIV only.

The inadvertent recruitment of previously identified PLHIV poses both challenges and opportunities. Repeat testing of PLHIV who are aware of their serostatus diverts public health resources, including testing costs and staff time. Conversely, the unintentional recruitment of PLHIV can yield important public health benefits, especially when their "recapture" provides a second opportunity to link them to care and, therefore, reduce onward transmission through antiretroviral therapy and risk-reduction counseling.[5] Incentives are likely a key driver of repeat testing among PLHIV, especially in our study where the majority of network associates had annual incomes under $10,000. Faced by the same challenge, the Baltimore City Health Department initiated a "Do Not Test" protocol, mandating a record search before HIV testing.[38] After 18 months, the proportion of HIV tests provided to previously diagnosed PLHIV declined from 2.6% to 0.4%, costs from repeat confirmatory testing decreased by 83.5%, and 70 PLHIV were relinked to medical care. We were able to reconnect 4 PLHIV to care, an unintended outcome of our study that nevertheless has public health value.

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TABLE 3. Effect of Flat Versus Variable Conditional Incentive Scheme on Recruitment of Priority group and High-Risk or HIV-Positive Network Associates

	Recruitment of Priority Group Network Associates*		Recruitment of High-Risk or HIV-Positive Network Associates†	
	Unadjusted‡	Adjusted§	Unadjusted‡	Adjusted§
Logistic Model, Any Recruits				
Flat incentive	1.0 (—)	1.0 (—)	1.0 (—)	1.0 (—)
Conditional incentive	1.59 (0.86 to 2.96)	0.92 (0.27 to 3.13)	1.15 (0.34 to 3.87)	0.89 (0.06 to 13.06)
Poisson Model, No. Recruits				
Flat incentive	1.0 (—)	1.0 (—)	1.0 (—)	1.0 (—)
Conditional incentive	1.02 (0.74 to 1.41)	0.84 (0.45 to 1.58)	0.88 (0.46 to 1.66)	0.79 (0.23 to 2.71)
No. observations	291	291	291	291
Nonzero observations	129	129	107	107
Wald χ^2	0.02	30.36	0.16	59.97
Prob > χ^2	0.89	<0.01	0.69	<0.01

*Values are presented as OR (95% CI) unless otherwise indicated. Priority groups were (1) individuals who had never received services at the community agency before; (2) injection drug users who had never been to a syringe exchange or used the roving exchanges; (3) individuals who had never been tested for HIV infection or not been tested in the last 12 months; and (4) individuals who were released from prison in the last 12 months.

†Participants were classified as high risk if, in the last 12 months, they engaged in any of the following activities: sex in exchange for drugs/money; injected drugs; had sex with another man, if male (MSM); had sex with someone who injects drugs or is HIV positive; had unprotected sex with someone of unknown HIV status; had ≥1 sex partner; or was diagnosed with a sexually transmitted infection (STI).[30]

‡The logistic outcome (presented as ORs) models the likelihood of membership in the "no recruits" versus "some recruits" groups and the Poisson outcome (presented as ratios of the number of recruits from 2 covariate levels) models number of recruits. The Poisson model is a ZIP regression model with a binary indicator variable for randomization arm and robust standard errors to account for clustering within network.

§Adjusted analyses also include community agency, age, sex, high risk (versus low risk), HIV serostatus, and unprotected sex with someone of unknown HIV status in the previous 12 months.

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Our study adds to the growing literature on "demand-side" incentives for HTC[24,25] and is the first, to our knowledge, to evaluate the efficiency of different recruitment incentive strategies within the RDS framework. We found that, although incentives were crucial for motivating recruitment (55% of study participants reported that the incentives were one of the reasons for study participation; data not shown), there was no difference in the number or risk profiles of recruits between the flat and the conditional incentive schemes. This might be because of the limitations of our pilot study, including being underpowered, incentive amounts that were too similar, higher than expected membership in the priority groups, and/or the conditional incentive scheme being too complex for participants to understand. Regardless, in both incentive schemes, we achieved our goal of recruiting high-risk individuals who would undoubtedly benefit from HIV prevention services— the majority reported high-risk behavior in the past year and nearly a quarter had never been tested for HIV infection. Our findings support the conclusion that the simpler, flat payment was sufficient to achieve this objective. However, only 45% of study participants recruited at least 1 other person, even with the offer of relatively large incentives and a very low-income population.

We also found that networks initiated by PLHIV may result in higher proportions of high-risk or HIV-positive network associates compared with networks initiated by HIV-negative seeds. Although we did not find a statistically significant difference, the direction of the effect is consistent with previous studies. For instance, when partner counseling and referral services are evaluated, networks of PLHIV contain a high proportion of undiagnosed PLHIV.[39] Other social network studies, outside of the partner counseling and referral services setting, have found that enlisting PLHIV as recruiters is an efficient way to identify newly diagnosed PLHIV.[15,17] Together, these studies reinforce the value of including PLHIV as partners in community HIV prevention efforts. However, given that none of the HIV-positive network associates recruited others, a more tailored strategy to encourage them to promote HTC may be needed, as recently diagnosed individuals must cope with discovering their status, notify at-risk partners, contemplate disclosure to friends and family, and initiate, establish, and adhere to medical care.

HTC represents a critical obstacle to realizing the potential of recent treatment and prevention breakthroughs and reducing the dramatic racial disparities in the domestic epidemic. Our findings add to the growing evidence base highlighting the value of social network approaches as an efficient and nonstigmatizing strategy to increase demand for HTC, identify people living with HIV infection who are unaware of their status, and as a potential way to recapture PLHIV who are out of care. Rigorous studies comparing the efficiency between social network strategies and conventional HTC strategies for identifying newly diagnosed PLHIV are needed to better understand how social network strategies can be used to achieve the objectives of the National AIDS Strategy.

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