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PROMOTION AND PERSISTENCE OF HIV TESTING AND HIV/AIDS KNOWLEDGE: EVIDENCE FROM A RANDOMIZED CONTROLLED TRIAL IN ETHIOPIA

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ABSTRACT

We use data from a randomized controlled trial in Ethiopia and examine the causal effects of HIV/AIDS education, home-based voluntary HIV counseling and testing (VCT), and conditional cash transfers (CCT) for facility-based VCT on HIV/AIDS knowledge and demand for HIV testing. HIV/AIDS education significantly increases HIV/AIDS knowledge but has a limited effect on testing take-up. However, when HIV/AIDS education is combined with either home-based VCT or CCT for facility-based VCT, take-up increases substantially by about 63 and 57 percentage points, respectively. We also demonstrate evidence of persistence in test-taking behavior, where past HIV testing does not dampen demand for testing. Lastly, we find suggestive evidence that home-based VCT could be more effective at detecting HIV-positive cases relative to CCT for facility-based VCT. Our findings highlight the importance of geographic accessibility in the testing decision and persistence in demand for HIV testing. Copyright © 2016 John Wiley & Sons, Ltd.

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1. INTRODUCTION

Over the last two decades, there have been significant improvements in access to voluntary HIV counseling and testing (VCT) and antiretroviral therapy (ART) as well as reductions in new HIV infections and AIDS-related deaths. In particular, around eight million people had received ART as of 2014, while the number of AIDS-related deaths in Sub-Saharan Africa declined by about 22% between 2001 and 2012 (UNAIDS, 2015).

VCT has been an integral part of the global response to the AIDS epidemic, both as a gateway for treatment and as a preventive strategy (Alagiri, 2001; Granich *et al*., 2009). While HIV testing is free in many resource-poor countries (De Cock *et al*., 2006), VCT take-up is still low; hence, it needs to be enhanced to ensure the early detection of HIV infections to pave the way for ART. For example, only about 11% of adults in 45 countries in Sub-Saharan Africa and one-quarter of the 125 million pregnant women in low-income and middle-income countries received VCT in 2009 (WHO, 2010). Low-test take-up means not only that many infected with HIV are unaware of their status but also they may unknowingly transmit the virus to others.

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Limited awareness of the need for and benefits of HIV testing, limited access to VCT, fear of stigma and discrimination, and limited availability and access to quality HIV care and treatment services are among the factors contributing to low-HIV testing rates around the world (WHO, 2014).

We study the causal effects of HIV education, home-based VCT, and conditional cash transfers (CCTs) for facility-based VCT on HIV/AIDS knowledge and demand for HIV testing. Our study design involves three treatments and two rounds of experiments that randomly provide HIV testing and HIV/AIDS education. As shown in Figure 1, during the first round, three randomly selected treatment groups are offered three (overlapping) treatments: door-to-door HIV/AIDS education (Group 1), door-to-door HIV/AIDS education and home-based VCT (Group 2), and door-to-door HIV/AIDS education and CCT for facility-based VCT (Group 3). No treatment is offered to a fourth group of randomly selected households (control group). During the second round, half of the households in each of the four research groups from the first round are randomly assigned to a home-based VCT group, whereas the other half are assigned to a facility-based VCT group.

In the health belief model as outlined by Rosenstock (1966), health-related information obtained from mass media campaigns or health professionals can affect individuals' likelihood of taking a health-related action if it affects their perceived threat of a health problem or the benefits of taking a health-related action. Therefore, HIV/AIDS education could be important in promoting demand for testing by enhancing awareness of the HIV epidemic and the benefits of HIV testing, especially for those with no formal education and/or limited access to relevant information. Indeed, bridging the health-related 'knowledge gap' might be a necessary condition to induce appropriate health-seeking behavior.

On the other hand, when geographic access to health services is limited, health service utilization could be low, even among health-literate individuals (Arcury *et al*., 2005; Buor, 2003; Joseph and Phillips, 1984). Specific to HIV testing, the long and arduous travel to a VCT clinic can decrease test take-up by increasing the direct and indirect costs of testing. In addition, psychological challenge posed by the fear of rejection by a partner following an HIV-positive status can discourage test take-up (Van Dyk and Van Dyk, 2003; Maman *et al*., 2001). Various VCT delivery models, such as home-based, mobile, and workplace, have been pursued to increase VCT access, especially among groups who may have limited VCT access through the formal health sector. For example, Baird et al. (2014), Mutale et al. (2010), Angoli et al. (2009), Obare et al. (2009), Wolff et al. (2005), and Yoder et al. (2006), all find high-test take-up rates under home-based VCT. Fylkesness and Siziya (2004) find testing take-up under home-based VCT to be almost five times higher than that under facility-based VCT in Zambia.[1]

Test take-up under home-based VCT can be high because it effectively eliminates the barriers of cost, travel time, and inconvenience (Wolff *et al*., 2005). Home-based VCT can promote testing by mitigating the social costs of visiting a publicly located testing clinic and the intra-couple bargaining power differences that may discourage women from visiting testing clinics (Yoder *et al*., 2006). Thus, home-based VCT can be more effective at reaching groups with low rates of prior testing and promoting couple counseling and testing (Menzies *et al*., 2009).

Despite evidence of the effect of home-based VCT on testing take-up, our understanding of the effectiveness of home-based VCT compared with other VCT provision models is limited (Bateganya *et al*., 2010). For example, cash incentives can also increase testing take-up by compensating individuals for transportation costs and the opportunity cost of taking time off to travel to a remote testing clinic.While the use of financial incentives in anti-poverty programs (such as Mexico's Oportunidades) is quite common, the use of such incentives to promote HIV testing is relatively limited, although growing.

Thornton (2008) and Ngatia (2011) find that small cash incentives have a significant positive effect on demand for HIV testing in Malawi. In another randomized trial in Tanzania, De Walque et al. (2012) examine the links between cash incentives and safe sexual behavior over a year, where study participants were tested for four curable sexually transmitted infections (STIs) every 4 months. They find a stronger and negative effect

[1]They examine testing take-up using a population-based HIV survey by comparing take-up under clinic-based VCT with that under 'optional location' VCT, where survey participants are given a choice between home-based VCT, clinic-based VCT, and VCT at a place of their choice, to examine the effects of perceived improved privacy and ease of access on testing decisions.

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of cash incentives on the combined prevalence of STIs among individuals offered a reward of $20 per testing round, relative to those offered $10 per testing round.[2]

The success of different VCT delivery channels (e.g., home-based and mobile VCT) depends not only on their effects on overall test take-up but also on their success in detecting HIV-positive cases. A differential rate of detection may happen if individuals with certain characteristics (e.g., those with high risk sexual behavior) find a specific VCT delivery channel to be more convenient than other VCT delivery channels. For example, if spousal pressure on those with risky sexual behaviors (and thus a higher likelihood of being infected with HIV) is a crucial determinant of the testing decision, the test acceptance rate for those with risky sexual behavior could be higher under home-based VCT offered to couples than facility-based testing. This would lead to more detection of HIV-positive cases under home-based VCT than facility-based testing.

Also important from a policy perspective is whether there is persistence in HIV test-taking behavior, which is crucial for the early detection of HIV infections. If past and future HIV testing are substitutes, individuals who tested in the past could be less likely to test in the future and vice versa. On the contrary, if past and future HIV testing are complements, a one-time investment to promote testing take-up will positively affect future test take-ups. Therefore, we also examine whether there exists persistence in test-taking behavior.

Our empirical analyses show a number of results. First, HIV/AIDS education significantly increases HIV/AIDS knowledge but has a limited effect on testing take-up. Second, when HIV/AIDS education is combined with home-based or facility-based VCT, take-up increases substantially by about 63 and 57 percentage points, respectively, relative to the control group. Third, although the test take-up rate is not statistically different between home-based and facility-based VCT, we find suggestive evidence of the former to be more effective at detecting HIV-positive testers. Fourth, we do not find that previous HIV testing dampens demand for HIV testing.

To the best of our knowledge, this paper is the first to credibly explore, in a similar setting and within a randomized controlled trial (RCT) framework, the relative effectiveness of HIV education, home-based VCT, and facility-based VCT on demand for HIV testing. This is also the first study that investigates the persistence of HIV testing and examines the causal effects of HIV/AIDS education on testing decisions in a developing country context, through an RCT design.[3]

The remainder of the paper is organized as follows. Section 2 discusses the study setting, experimental design, and data. Section 3 outlines the estimation strategy employed to identify the treatment effects. Section 4 presents the regression results. Section 5 discusses the results before concluding the paper in Section 6.

2. STUDY SETTING, EXPERIMENTAL DESIGN, AND DATA

2.1. Setting and study sample

Ethiopia is the second largest country in Africa with one-third of its population living on less than $1.25 purchasing power parity per day in 2011 (World Bank Group, 2015). The adult HIV prevalence rate was estimated to be 1.5% in 2013 with a higher prevalence rate estimated in urban areas (4.2%) than rural areas (0.6%) and among women (1.9%) than among men (1%) (FDRE, 2014). According to recent UNAIDS estimates, there were more than one million people living with HIV/AIDS and 45,000 AIDS-related deaths in 2013. Estimates based on the Ethiopian Demographic and Health Survey show improvements in the number of HIV testers as well as awareness about HIV/AIDS. For example, about 4% of adult women (aged 15–49) and 5% of adult men in 2005 tested for HIV and received results, while the corresponding figure was about 36% and 38% for adult women and men, respectively, in 2011 (CSA, 2006; CSA, 2012).

[2]These findings differ from those of the aforementioned studies of the effects of cash incentives; indeed, the authors note that the effects of cash incentives on sexual behavior could depend on contextual and program design-related factors such as the frequency with which the incentives are disbursed.

[3]However, a number of studies have examined the effect of sex and AIDS education, finding a negative effect on the likelihood of single motherhood and on teenage pregnancy (Duflo *et al*., 2014; Dupas, 2011), a positive effect on practical knowledge and condom use (Duflo, 2006), and a positive effect on the likelihood of condom-protected sexual intercourse (Tremblay and Ling, 2005).

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Our study area is Hetosa district of Arsi zone in Ethiopia, with a population of around 124,000 spread over 23 rural *Kebeles*, which is composed of 108 enumeration areas (EAs), and two urban *Kebeles*.[4] Hetosa district has limited health service coverage, including HIV/AIDS-related services; according to an unpublished report from the district health bureau, the HIV-positive rate was 2.5% in 2008.

The sample of this study is drawn from participants of the Korea–Ethiopia–Yonsei family planning (KEYFP) baseline survey that collects information on family planning knowledge, attitude, and practice as well as HIV/AIDS knowledge.[5] KEYFP researchers randomly selected six EAs (from the 108 EAs in the 23 rural *Kebeles*) and one of the two urban *Kebeles*. KEYFP team initially planned to conduct a census of households in all the sampled rural EAs. However, after a census of four EAs was completed, the team decided to survey only 60% of the households in the rest of the EAs because of time and budgetary constraints.[6] From the one urban *Kebele*, 14% of households were randomly selected in order to keep the representativeness of the KEYFP sample in line with the rural/urban composition of the district.[7]

Three groups of individuals were selected from sampled KEYFP households: an adult man (aged 20 to 59), an adult woman (aged 20 to 49), and an adolescent (aged 15 to 19). In households with more than one eligible member per group, one was chosen through a lottery. The KEYFP survey included 1850 individuals and 1009 households. The sample for this study includes all KEYFP survey participants except individuals between the ages of 15 and 17.[8] As a result, 1658 individuals in 959 households were eligible to participate in this study.

2.2. Experimental design

As summarized in Figure 1, the study design involves three rounds of surveys and two rounds of experiments. We also present a simple chronological summary of the experimental design in Table B1. The experiments were carried out in April 2010 (first round) and October 2010 (second round), and the surveys were conducted in May 2009 (baseline), June 2010 (first round), and October 2010 (second round).[9] The randomization for the two round of experiments was carried out at the household level.[10] For the first-round experiment, eligible households were randomly assigned into four research groups: three treatment arms (Groups 1 to 3) of 20% each and a control group (Group 4) of 40%. For the second-round experiment, eligible households in each of the four research groups from the first-round experiment were randomized into two equal groups. The treatment arms during each round of experiments are discussed subsequently.

2.2.1. First-round experiment. The three treatment groups (Groups 1 to 3) were offered three (overlapping) treatment arms: door-to-door HIV/AIDS education (Group 1), door-to-door HIV/AIDS education and home-based VCT (Group 2), and door-to-door HIV/AIDS education and CCT for facility-based VCT (Group 3). The control group (Group 4) was not offered any treatment during the first-round experiment.

[4] A *Kebele* is the smallest administrative unit in Ethiopia. The Central Statistical Agency of Ethiopia has divided rural *Kebeles* further into clusters of households, known as enumeration areas (EAs). Each EA contains about 150 to 200 households.

[5] The KEYFP project, funded by Korea International Cooperation Agency (KOICA), aims to provide family planning services, improve awareness of family planning service providers, and strengthen community support for family planning; it does not involve the randomization of beneficiaries.

[6] As discussed later, our regression analysis weighs observations from rural EAs where only 60% of households were surveyed by 1.67

[7] See Section B of Appendix 2 in the Supporting Information for the details of the sampling method.

[8] Given the relatively large number of visits, our research team was going to make and the need to obtain written informed consent from the parents or legal guardians of minors, including minors in our study would have been logistically difficult.

[9] The second-round intervention and the second follow-up survey were implemented in October 2010 simultaneously. Specifically, we first interviewed study participants and offered HIV testing right after the survey had been completed. For Group 4, HIV/AIDS education was provided after the second follow-up survey but before the HIV testing offer, as shown in Figure 1.

[10] While the individual-level randomization of eligible subjects would have increased, the effective sample size improved statistical efficiency and allowed us to examine possible intra-household spillover effects; randomization was carried out at the household level to reduce potential intra-household experimental contamination and improve compliance as well as for ethical considerations. Intra-household contamination would have been a serious concern, especially for the HIV/AIDS information treatment, because HIV/AIDS information could have easily been shared among household members randomly assigned to the control group. Further, individual-level randomization can cause intra-household disagreements if, for example, a cash incentive is offered to the wife but the husband is assigned only HIV education or vice versa.

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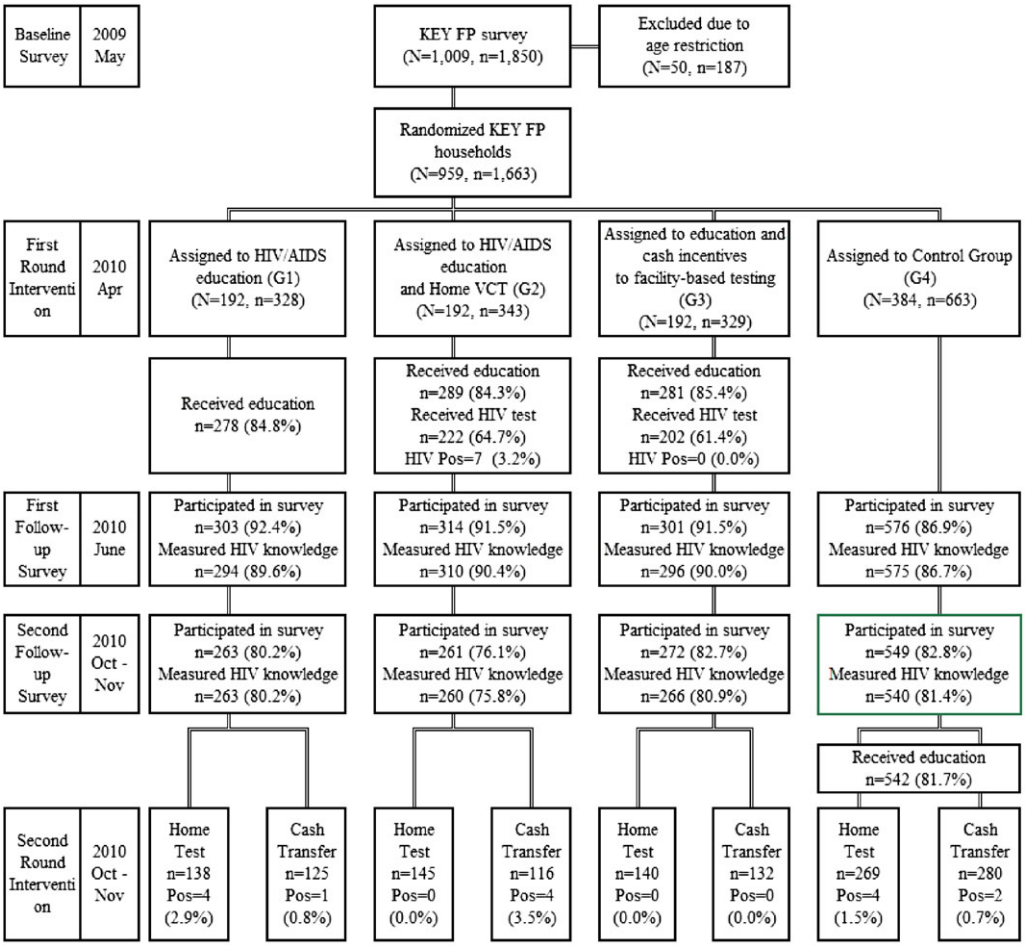
2.2.1.1. Door-to-door HIV/AIDS education session (Groups 1 to 3). The door-to-door HIV/AIDS education session consists of an HIV/AIDS information session and a provision of a VCT promoting poster. HIV/AIDS information session addressed ways of HIV transmission, the advantages (and potential problems) of HIV testing, ways of learning ones HIV status in the study area, and access to AIDS and other medication that can reduce the risk of mother-to-child HIV transmission. The information session was led by properly trained community-based health workers, known as health extension workers (HEWs), and lasted 30 to 45 min. If more than one eligible household member was present during a home visit by an HEW, the information session was conducted as a group inside or outside the residence, whichever was deemed better to ensure privacy. At the end of the information session, HEWs presented one poster that promoted VCT (to each household) and hung it in a visible place on the wall of the residence of the study household.

2.2.1.2. Home-based VCT (Group 2). Free home-based VCT was offered to eligible subjects in Group 2. At the end of the HIV/AIDS education session, HEWs offered a free home-based VCT and, if interested, made appointments between 9AM and 5PM in the following 10 days (starting right after the information session).



Notes: KEYFP = Korea-Ethiopia-Yonsei Family Planning; "N" and "n" stand for number of households and individuals, respectively; "Pos" means HIV-positive cases.

Figure 1. Study design

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Community-based VCT providers, known as community counselors (CCs), from nearby districts visited eligible subjects in Group 2 per the appointment set by HEWs. We recruited CCs from nearby districts into the research team for the sake of confidentiality. The CCs conducted HIV testing in line with Ethiopia's guidelines for HIV counseling and testing and under the condition of the 'Three Cs': informed consent, confidentiality, and counseling. Pre-test counseling, HIV testing, and post-test counseling (and test results) were all carried out in a single visit and in private (to couples). Testing was conducted by using rapid test kits and finger-prick blood samples. No subject was given a written HIV test result, and HIV seropositive subjects were referred to a nearby hospital for follow-up.[11]

2.2.1.3. Cash incentives for facility-based VCT (Group 3). Cash incentives were given to those in Group 3 to compensate for the cost of round-trip transportation and a day of lost farm wages due to a trip to an assigned testing clinic in the capital of Hetosa district (Iteya Health Center). Coupon values ranged between $1.5 and $2.9, depending on the distance between the study *Kebele* and the assigned testing clinic.[12]

At the end of the HIV/AIDS education session, HEWs informed participants that they would receive cash compensation if they wished to learn their HIV status. If interested, HEWs handed out coupons (one per eligible individual) and explained the conditions for coupon redemption. Coupons were non-transferable and redemption was conditional on subjects learning their HIV status at the assigned testing clinic before coupons expired in 10 days. HIV counseling and testing at the clinic was carried out in the usual manner and free of charge.

2.2.2. Second-round experiment. The second-round experiment was carried out in October 2010 right after the second-round follow-up interviews had been conducted. For the second round of intervention, we re-randomized eligible households in the four research groups from the first-round experiment (Groups 1 to 4). Each of the four groups was randomized into two equal groups with the first sub-group offered free home-based VCT and the second sub-group offered cash incentives for facility-based VCT.

Home-based VCT was offered and carried out for individuals in the four eligible home-based VCT sub-groups using similar procedures to those discussed earlier. Second-round coupon values ranged between $1.8 and $2.9. [13] After the second-round experiment and follow-up survey, HIV/AIDS education was offered to individuals randomly assigned to the control group during the first-round experiment (Group 4).

2.3. Data

Table I presents the summary statistics for the whole sample (Column 1) as well as the control group (Column 2). Panels A and B present individual-level and household-level summaries, respectively. These show that the sample had an average age of about 32 years, with an almost equal proportion of men and women. About three-quarters of subjects were married, 13% had no formal education, and 80% were involved in an income-generating activity in the month prior to the baseline survey. About 61% of the population in the district was Orthodox Christian and 38% Muslim. With regard to baseline HIV/AIDS-related knowledge, respondents provided the correct response to four of the six questions asked, on average. For those that had sex in the last 3 months, 4.8% reported their last sexual encounter to be a non-live-in boyfriend or girlfriend, and 1.4%reported a casual acquaintance or a commercial sex worker.

Columns 3 to 8 in Table I show that the four groups were well balanced. They present the mean differences and significance levels between each of the three treatment groups and the control group. Five of the 96 (5.2%)

[11] The antiretroviral therapy clinic at the zonal referral hospital in the nearby town of Asella (Asella referral hospital) provides screening and HIV treatment (if necessary) free of charge with support from the International Center for AIDS Care and Treatment Programs.

[12] The transportation cost was computed based on bus and horse carriage fares from each study village to the Iteya Health Center. The lost daily farm wage was computed based on the daily wage rate for adult agriculture labor at the time of the first-round experiment, based on information we collected from district agricultural bureau offices. Section A of Appendix 2 in the Supporting Information provides details about the cash incentives.

[13] Cash incentives for subjects in the four eligible incentive sub-groups were adjusted upwards to account for the inflationary effects of a 20% devaluation of the local currency that took place between the first-round and second-round experiments (in September 2010).

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Table I. Summary of baseline characteristics

Variable	Obs	All (1)	Control(G4) (2)	G4 vs. G1 (3)	G4 vs. G2 (4)	G4 vs. G3 (5)	G2 vs. G3 (6)	G1 vs. G2 (7)	G1 vs. G3 (8)
Panel A. Individual characteristics									
Age	1663	31.51	31.67	0.161	0.209	−1.154	1.364*	−0.048	1.316
Men	1663	0.512	0.531	−0.068**	−0.006	−0.023	0.017	−0.061	−0.044
Married	1663	0.738	0.742	0.002	−0.025	0.003	−0.027	0.027	−0.001
Engaged in economic activity	1663	0.802	0.828	−0.017	−0.067**	−0.044*	−0.023	0.050	0.027
Had formal education	1663	0.870	0.866	0.021	−0.023	0.022	−0.045*	0.045*	0.000
Illiterate	1663	0.341	0.335	0.004	0.018	0.009	0.009	−0.014	−0.005
Religion									
Orthodox Christian	1663	0.605	0.644	−0.046	−0.052	−0.097***	0.045	0.006	0.050
Muslim	1663	0.377	0.339	0.030	0.054*	0.104***	−0.050	−0.025	−0.075*
Satisfied with health status	1660	0.854	0.861	0.013	−0.025	−0.026	0.001	0.038	0.039
HIV/AIDS-related knowledge score	1663	0.728	0.738	−0.027	−0.015	−0.012	−0.003	−0.012	−0.015
Know HIV testing center	1663	0.608	0.591	0.028	0.024	0.032	−0.008	0.004	−0.004
Have a regular sex partner	1410	0.892	0.893	−0.016	−0.009	0.022	−0.031	−0.007	−0.038
Unsafe sex (Not used condom in last sex)	1342	0.829	0.801	0.062*	0.023	0.056*	−0.033	0.006	0.039
Relationship with last sexual partner									
Spouse/fiance/ cohabiting partner	1415	0.934	0.931	0.015	0.024	−0.023	0.047**	−0.008	0.038*
Non live-in boyfriend or girlfriend	1415	0.048	0.046	−0.007	−0.004	0.021	−0.025	−0.002	−0.028
Casual acquaintance or commercial sex worker	1415	0.014	0.018	−0.007	−0.014*	0.004	−0.018*	0.007	−0.010
Panel B. Household characteristics									
Area of residence: rural	959	0.900	0.906	0.005	−0.005	−0.031	0.026	0.010	0.036
Came from another area	853	0.155	0.149	−0.017	0.020	0.025	0.013	−0.022	−0.009
Own land	848	0.875	0.880	0.005	0.015	−0.045	0.047	0.005	0.052*
Own ox(en)	960	0.763	0.783	−0.023	−0.044	−0.038	−0.025	0.122	0.097
Own electricity	847	0.216	0.193	−0.003	0.057	0.058	0.031	−0.094**	−0.062
Own radio	848	0.726	0.751	−40.011	−0.071*	−0.039	−0.031	0.005	−0.026
Own television	850	0.073	0.081	−0.023	−0.017	0.001	−0.026	0.000	−0.026

Notes. The table reports means of selected baseline variables. G1 represents those who were offered door-to-door HIV/AIDS education only. G2 represents those who were offered door-to-door HIV/AIDS education and home-based VCT. G3 represents those who were offered door-to-door HIV/AIDS education and a cash incentive for facility-based VCT. G4 represents those who are in the control group. Panel A summarizes individual level information, and Panel B summarizes household level information. Columns 1–2 show a summary for the whole sample and for subjects initially assigned to the control group, respectively. Columns 3–8 report mean differences (and significance levels for difference of mean tests) between research groups with different treatment status during first-round randomization. *Significant at 10%; **Significant at 5%; ***Significant at 1%.

(Panel A) and one of the 42 (2.4%) (Panel B) mean differences are statistically significant at the 5% significance level (or less), suggesting that our randomization was generally successful in creating balanced research groups.

The main outcome variables of interest in this paper were HIV/AIDS knowledge and test take-up. An indicator of HIV/AIDS knowledge was constructed based on six questions about whether the individual is knowledgeable about the fact that abstinence, being faithful to one's partner, and the consistent use of condoms (the 'ABC' of HIV prevention) reduce the chance of HIV infection and that HIV can be transmitted from a mother to her child during pregnancy, delivery, or breastfeeding.[14] Response options were coded as 'agree with', 'disagree with', and 'do not know', and they were rescaled to an indicator that takes one if the respondent agrees to a correct sentence and zero if the respondent either disagrees to a correct sentence or states 'do

[14]The following are some of the sentences read out to study subjects: 'Someone who abstains from sexual intercourse has less chance of being infected with HIV', 'Individuals who use condoms correctly and every time they have sex have less chance of being infected with HIV', and 'Being in a faithful relationship with only one individual (who does not have HIV/AIDS) reduces one's chance of being infected with HIV'.

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not know'.[15] An HIV/AIDS knowledge score was then constructed by taking the fraction of correct responses. For the regression analysis, the knowledge score was normalized with reference to the control group.

HIV testing take-up information was derived from administrative and survey sources. Administrative testing data refer to HIV testing status in response to the two rounds of intervention we offered (home-based VCT and cash incentives). Self-reported testing data refer to the data on testing status we collected during the follow-up surveys, regardless of whether the testing was in response to the incentives we provided.

We were able to track about 90% and 81% of study subjects during the first and second follow-up interviews, respectively (Figure 1 and Table A1 in the Supporting Information). The main reasons for attrition are temporary relocation (36%), absenteeism during home visits (21%), and refusal (14%).[16] Table A1 in the Supporting Information shows that individuals from the three treatment groups are more likely to participate in the first follow-up survey than those in the control group, but no differential attrition is observed during the second follow-up survey, except for Group 2.[17] However, there is no differential attrition between home-based HIV testing (Group 2) and facility-based testing (Group 3) as shown in Columns 5 and 6.

These differential attritions may drive some of the inter-group differences we present in Section 4. To address this concern, we carried out a bounding exercise in the spirit of Lee (2009), imputing the extreme values for some of the missing observations. Specifically, we replaced 32 missing values in the control group with the value that decreases (minimizes) the treatment effect because having 32 more observations in the control group in the first follow-up survey allows us to have a balanced follow-up response rate across the treatment and control groups.[18] Therefore, imputing the extreme values gives us the most conservative results. In terms of HIV testing take-up, we replaced 32 control group missing values on HIV testing in the first follow-up survey with an extreme value (i.e., 1) to minimize the treatment effect (Column 2 in Table III). In terms of HIV/AIDS knowledge, we assigned different knowledge scores in increments of 0.01, from 0.78 (average of the control group) to 1.00, to the randomly selected 32 people in the control group. Imputing 1, of course, would show a lower bound of the treatment effect.

3. EMPIRICAL ESTIMATION STRATEGY

We employ an intention-to-treat analysis to compare the post-treatment outcomes of different groups during the first and second follow-up. Specifically, we estimate the reduced-form linear probability model in Equation 1:

$$Y_{ij} = \beta_0 + \beta_1 G1_{ij} + \beta_2 G2_{ij} + \beta_3 G3_{ij} + \mathbf{\Pi X}_{ij} + \mu_j + \eta_{ij} \tag{1}$$

where Y measures the two outcomes of interest: HIV testing status and HIV/AIDS knowledge. i and j are the indices for individual and village, respectively. G1, G2, and G3 are indicators of assignment to Groups 1, 2, or 3, respectively. $\mathbf{X}$ is a vector of the observable baseline characteristics, including age dummies, sex, marital status, religion, schooling, employment status, area of residence, household asset ownership, and baseline HIV knowledge; μ_j indicates the village fixed effects; and η_{ij} is a random error term.[19] Heteroscedasticity-robust standard errors from all regressions are clustered at the household level. All our regressions are weighted to account for the fact that our sample consists of 60% of households in two study EAs but 100% of households in four study EAs.[20]

[15] Depending on the specific question, the proportion of individuals who replied 'do not know' varied between 1% and 5%.

[16] We observed a relatively high attrition among adolescents and young adults because they are more likely to relocate to urban *Kebeles* or nearby towns to pursue a job or their secondary education.

[17] We also find evidence of differential attrition among married respondents, suggesting a disproportionally small sample of mobile individuals during the follow-up surveys.

[18] The first-round follow-up rate is 91.8% in the treatment groups (Groups 1 to 3) and 86.9% in the control group. The 32 additional observations are computed as $(663 * (91.8\% - 86.9\%)/100)$, where 663 is the number of individuals assigned to the control group during the first-round experiment.

[19] The results from a regression without a control vector are similar.

[20] The observations from the *Kebeles* with random sampling of 60% of the households are weighted by 1.67. The results based on simple ordinary least squares regression, not reported here, are similar to the weighted regression estimates.

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To examine persistence in test taking behavior, we estimate the linear model in Equation 2:

$$Tested_{ij} = \alpha_0 + \alpha_1 2ndOffer_{ij} + \alpha_2 NoCondom_{ij} + \alpha_3 2ndOffer * NoCondom_{ij} + \mathbf{\Pi X}_{ij} + \mu_j + \eta_{ij} \quad (2)$$

where *Tested* measures HIV test take-up measured in the second follow-up survey (self-reported) or the second experiment (administration data) for individual *i* in village *j*. *2ndOffer* is an indicator of being offered the second HIV testing, and *NoCondom* equals one if a respondent had sexual intercourse without a condom in the last 3 months and zero otherwise. The coefficient α_1 presents complementarity/substitutability for those that do not engage in risky sex, and α_3 presents the difference in complementarity/substitutability between those that do engage in risky and safe (or no) sex. Recall that during the second-round experiment, incentives were provided to Groups 2 and 3 for the second time and Groups 1 and 4 for the first time. Therefore, an insignificant 1 suggests persistent test-taking behavior. Recall that during the second-round experiment, incentives were provided to Groups 2 and 3 for the second time and Groups 1 and 4 for the first time. Therefore, an insignificant coefficient estimate for the variable '*2ndOffer* (Those in G2 or G3)' is evidence of *persistent* test-taking behavior.

4. RESULTS

4.1. Impact of HIV/AIDS education on HIV/AIDS knowledge

We first present the regression results on the causal effect of door-to-door HIV/AIDS education on HIV/AIDS knowledge. Figure 2 summarizes the core HIV/AIDS knowledge measure defined in Section 2 at baseline and for the follow-up surveys. While there is no significant difference between the treatment and control groups at baseline, we observe significant improvement in HIV/AIDS knowledge in the treatment group during the first follow-up survey, conducted about 3 months after the information session. However, the 'knowledge gap' between the treatment and control groups observed at the first follow-up disappears during the second follow-up. The dissipation of the HIV/AIDS knowledge gap could have been driven by the increase in HIV/AIDS knowledge in the control group as well as the fading of HIV/AIDS knowledge in the treatment group.

We present these findings more formally with the regression results in Table II. Column 1 shows that the core HIV/AIDS knowledge level, measured after 3 months of HIV/AIDS education, increases by 0.8 to 0.12 standard deviations, depending on the treatment group.[21] Because the attrition rate in the control group is higher than that in the treatment groups, we perform bounding exercises by assigning extreme values of HIV/AIDS knowledge and HIV testing to the 32 people in the control group who did not participate in the first follow-up survey. Figure A1 in the Supporting Information shows that the treatment effects on HIV/AIDS knowledge are still large and statistically significant even after the bounding exercise. In addition, the coefficient estimates for Groups 1 to 3 are generally not significantly different, suggesting an insignificant effect of pre-HIV and post-HIV test counseling on HIV/AIDS knowledge.

Column 2 in Table II shows that the knowledge gap between each of the treatment groups and the control group disappears at the second follow-up. As shown in Figure 2, we find that HIV/AIDS knowledge in the treatment group decreases over time; however, we also find that HIV/AIDS knowledge appears to have increased over time for the control group even though we did not provide HIV/AIDS education to the control group during the first-round experiment.[22] To examine this point further, we exploit our unique sampling design discussed in Section 2.1. The KEYFP sample, from which the sample for this study was drawn, surveyed 100%

[21] Table A2 in the Supporting Information presents the impact estimates on each measure of HIV/AIDS knowledge during the first (Panel A) and second (Panel B) follow-up surveys. The results are similar across individual components of the HIV/AIDS knowledge index.

[22] While there could be a general time trend for HIV knowledge, an increasing time trend does not explain the changes in HIV/AIDS knowledge among the treatment groups.

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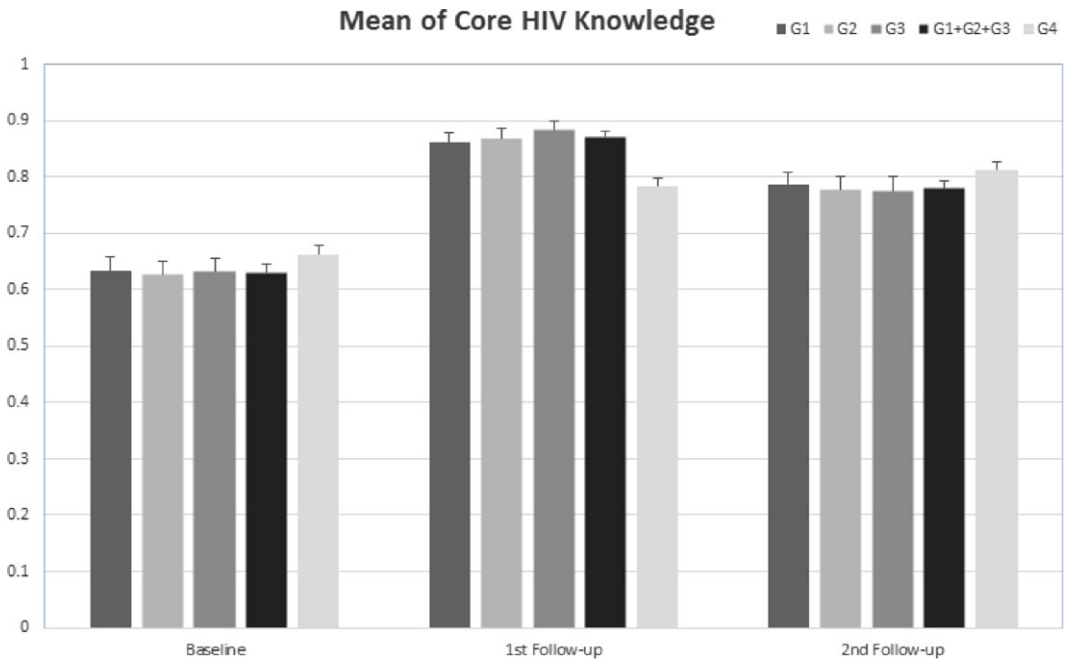

Notes: Figure 2 shows means of HIV/AIDS knowledge score by research group at baseline, first follow-up, and second follow-up, respectively. G1 represents those who were offered door-to-door HIV/AIDS education only. G2 represents those who were offered door-to-door HIV/AIDS education and home-based VCT. G3 represents those who were offered door-to-door HIV/AIDS education and a cash incentive for facility-based VCT. G4 represents those who are in the control group. HIV/AIDS knowledge is measured by an index that shows the percentage of correct responses about the "ABC" of HIV prevention and about mother-to-child HIV transmission during pregnancy, delivery, and breastfeeding. Also reported are 95% confidence intervals.

Figure 2. Level of HIV/AIDS knowledge

and 60% of the households in four and two of the sample rural EAs, respectively. As shown in Panel A of Table A3, the number of households per EA is comparable, but the number and rate of treatment households is greater in the 100% EAs than in the 60% EAs.[23] As a result of this, the knowledge spillover might have been stronger in the 100% EAs than in the 60% EAs, resulting in positive and significant coefficients for the 100% sample EA dummy in the first round (Column 3) that disappeared in the second round (Column 4).[24]

4.2. Impact on the HIV testing decision

In this section, we discuss the results on the effect of HIV/AIDS education and incentives for HIV testing on demand for HIV testing. Table III presents the treatment effect on HIV testing in the first-round intervention. Each coefficient is based on either self-reported testing data (Columns 1 and 2) or administrative testing data from the experiment (Columns 3 to 5).[25] Column 1 shows that individuals in Groups 1, 2, and 3 are, respectively, 8, 63, and 57 percentage points more likely to report learning their HIV status than those in the control group.

[23] Suppose that each EA has approximately 200 households as it is designed. Given the composition of the treatment and control samples in our study (60% treatment and 40% control) and random sampling of households, our sample will have 120 treatment and 80 control households in the 100% EAs and 72 treatment and 48 control households in the 60% EAs.

[24] However, evidence of knowledge spillovers is only suggestive because there are other unbalanced individual and household characteristics (See Panels B and C of Table A3 in the Supporting Information).

[25] The data from the experiment capture only the HIV testing results obtained as part of the study but not those provided through other channels. However, HIV status information (Columns 4 and 5) is available only in the data from the experiment.

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Table II. Impact on HIV/AIDS knowledge

	HIV/AIDS knowledge			
Follow-up round	First (1)	Second (2)	First (3)	Second (4)
G1 (Edu)	0.079***	−0.024	0.080***	−0.025
	(0.015)	(0.017)	(0.015)	(0.017)
G2 (Home)	0.088***	−0.023	0.088***	−0.024
	(0.015)	(0.018)	(0.015)	(0.018)
G3 (Cash)	0.103***	−0.027	0.103***	−0.028
	(0.014)	(0.018)	(0.014)	(0.018)
100% Sample EA			0.047***	0.012
			(0.015)	(0.016)
Constant	0.672***	0.900***	0.663***	0.932***
	(0.047)	(0.055)	(0.040)	(0.048)
Control group mean	0.7843	0.8133	0.7843	0.8133
R-Squared	0.104	0.057	0.102	0.052
Observation	1475	1329	1475	1329
Control	Yes	Yes	Yes	Yes
Village Fixed Effects	Yes	Yes	No	No
F test (Prob > F)				
Edu = Home	(0.5906)	(0.9523)	(0.5899)	(0.9680)
Edu = Cash	(0.1172)	(0.9116)	(0.1164)	(0.9034)
Home = Cash	(0.2912)	(0.8674)	(0.2950)	(0.8754)
Edu = Home = Cash	(0.2756)	(0.9857)	(0.2756)	(0.9866)

Note: The table reports an effect of interventions on HIV/AIDS knowledge, measured by an index that shows the percentage of correct responses about the ABC of HIV prevention and mother-to-child HIV transmission during pregnancy, delivery, and breastfeeding, normalized with reference to the control group. G1 represents those who were offered door-to-door HIV/AIDS education only. G2 represents those who were offered door-to-door HIV/AIDS education and home-based VCT. G3 represents those who were offered door-to-door HIV/AIDS education and a cash incentive for facility-based VCT. Controls include age dummies, sex, marital status, religion, baseline HIV/AIDS knowledge, education, employment status, area of residence, household asset ownership (indicators for ownership of land, electricity, radio, television, mobile phone, and a measure of scaled livestock units). Robust standard errors clustered at household level are in parentheses. Results of F tests (p-values) for the equality of effect estimates for various pairs of treatment groups are also presented. A total of 100% sample EA stands for enumeration area where 100% of households were surveyed.
*Significant at 10%; **Significant at 5%; ***Significant at 1%.

As shown in the F-test results, the coefficient estimates for Groups 2 and 3 are not statistically different, suggesting that the type of incentive (CCT for facility-based testing versus home-based testing) does not have a significant effect on the testing decision.

The importance of cost barriers in the testing decision is evident from the fact that the test take-up increase of Group 1 is only one-eighth that of Groups 2 and 3, although HIV/AIDS knowledge improvement is comparable for all three treatment groups. Moreover, the effect of education in Group 1 is smaller and no longer significant in the bounding practice (Column 2).[26] The coefficient estimates based on self-reported data (Column 1) and experimental data (Column 3) are similar for Groups 2 and 3, suggesting that the increase in HIV testing in these two groups is driven by the incentives we offered them.

Columns 4 and 5 show the impact on learning an HIV-positive and HIV-negative status, respectively. The home HIV testing offer (Group 2) significantly increases learning an HIV-positive status but not facility-based

[26]As described in Section 2, we assume that the randomly selected 32 missing people in the control group received HIV testing in the bounding practice.

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Table III. Impact on HIV testing

Dependent variable	Learned HIV status	Learned HIV status (bounding)	Accept HIV testing offer	HIV tested positive	HIV tested negative
Experiment round data	Self-reported (1)	Self-reported (2)	First Administration (3)	Administration (4)	Administration (5)
G1 (Edu)	0.080**	0.035	−0.007	0.002	−0.009
	(0.035)	(0.035)	(0.008)	(0.001)	(0.008)
G2 (Home)	0.631***	0.583***	0.668***	0.021**	0.647***
	(0.030)	(0.031)	(0.028)	(0.009)	(0.029)
G3 (Cash)	0.566***	0.524***	0.638***	0.000	0.638***
	(0.032)	(0.033)	(0.029)	(0.001)	(0.029)
Constant	0.194*	0.238**	0.077	0.004	0.073
	(0.106)	(0.103)	(0.080)	(0.011)	(0.079)
Control group mean	0.182	0.225	0.000	0.000	0.000
R-squared	0.378	0.340	0.562	0.054	0.551
Observation	1476	1508	1663	1663	1663
F test (Prob > F)					
Edu = Home	(0.0000)	(0.0000)	(0.0000)	(0.0169)	(0.0000)
Edu = Cash	(0.0000)	(0.0000)	(0.0000)	(0.4308)	(0.0000)
Home = Cash	(0.0783)	(0.0860)	(0.4470)	(0.0159)	(0.8256)
Edu = Home = Cash	(0.0000)	(0.0000)	(0.0000)	(0.0540)	(0.0000)

Notes: The table reports effects on HIV testing take-ups, and learning HIV positive and negative in the first-round experiment. G1 represents those who were offered door-to-door HIV/AIDS education only. G2 represents those who were offered door-to-door HIV/AIDS education and home-based VCT. G3 represents those who were offered door-to-door HIV/AIDS education and a cash incentive for facility-based VCT. Controls include age dummies, sex, marital status, religion, baseline HIV/AIDS knowledge, education, employment status, area of residence, household asset ownership (indicators for ownership of land, electricity, radio, television, mobile phone, and a measure of scaled livestock units). Robust standard errors clustered at household level are in parentheses. Results of F tests (p-values) for the equality of effect estimates for various pairs of treatment groups are also presented.
*Significant at 10%; **Significant at 5%; ***Significant at 1%.

testing (Group 3), even though the test take-up rates in Groups 2 and 3 are similar. This is discussed further in Section 4.4. Learning an HIV-negative status is significant in both Groups 2 and 3, reflecting that the majority of those tested for HIV received an HIV-negative result.

4.3. Persistence of the HIV testing decision

We now analyze HIV testing data from the two rounds of experiments to examine persistency in test-taking behavior. Table IV presents the test take-up results based on the data from the second-round experiment where all study subjects were randomly offered incentives (home-based VCT or CCT for facility-based testing). To recall, the second-round survey was conducted right before the second-round offer of HIV testing was made, and the first-round experiment was carried out 6 months before the second-round experiment. Therefore, the HIV testing outcome indicators based on the self-reported survey data (Columns 1 and 3) equal one if an individual received testing in the last 3 months and do not capture HIV testing outside our offers from the experiments. That is, the outcome indicators do not capture HIV testing in either the first-round or the second-round experiment. As a result, we do not expect any changes in Columns 1 and 3. HIV testing in the second-round experiment (accept HIV testing offer) in Columns 2 and 4 is the dependent variable in which we are interested.

Column 2 in Table IV shows that, on average, previous HIV testing does not dampen demand for future HIV testing. Moreover, Column 4 shows that HIV testing in the past and in the future is neither complements nor substitutes for those who engage in or abstain from risky sexual practices. These results are discussed further in Section 5.

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4.4. Detection of HIV-positive cases

Table V compares the effectiveness of home-based and facility-based testing in detecting HIV-positive cases, exploiting the fact that both VCT options are offered randomly. Although the test take-up rate under the two options is similar, we find suggestive evidence that home-based testing detects more HIV-positive cases

Table IV. Persistence of HIV testing

Dependent variable	Learned HIV status	Accept HIV testing offer	Learned HIV status	Accept HIV testing offer
		Second		
Experiment round data	Self-reported (1)	Administration (2)	Self-reported (3)	Administration (4)
Second offer (G2 or G3)	0.001	0.036	−0.034	0.039
	(0.021)	(0.025)	(0.054)	(0.061)
Not used condom			−0.059	−0.049
			(0.044)	(0.046)
Second offer X not used condom			0.044	−0.005
			(0.058)	(0.065)
Constant	0.099	0.720***	0.216**	0.641***
	(0.092)	(0.104)	(0.096)	(0.108)
Control group mean	0.153	0.794	0.153	0.794
R-squared	0.028	0.088	0.030	0.088
Observation	1345	1345	1342	1342
Controls	Yes	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes	Yes

Notes: The table reports persistence of HIV testing. Controls include age dummies, sex, marital status, religion, baseline HIV/AIDS knowledge, education, employment status, area of residence, household asset ownership (indicators for ownership of land, electricity, radio, television, mobile phone, and a measure of scaled livestock units. Robust standard errors clustered at household level are in parentheses. Results of F tests (p-values) for the equality of effect estimates for various pairs of treatment groups are also presented.
*Significant at 10%; **Significant at 5%; ***Significant at 1%.

Table V. Home-based versus facility-based VCT in detecting HIV positives

	Detection of HIV-positive testers			
	First and second whole		First G2 and G3	Second G1 and G4
Experiment round sample	(1)	(2)	(3)	(4)
Home testing	0.018**	0.018**	0.021**	0.019*
	(0.007)	(0.007)	(0.009)	(0.011)
Constant	−0.030	−0.028	0.028	−0.034
	(0.024)	(0.023)	(0.018)	(0.036)
Control group mean	0.0109		0.0000	0.0111
R-squared	0.058	0.058	0.103	0.112
Observation	1484	1484	672	812
Controls	Yes	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes	Yes
Round fixed effects	No	Yes	No	No

Notes: The table compares the effectiveness of home-based testing and CCT for facility-based testing in detecting HIV-positive cases. G1 represents those who were offered door-to-door HIV/AIDS education only. G2 represents those who were offered door-to-door HIV/AIDS education and home-based VCT. G3 represents those who were offered door-to-door HIV/AIDS education and a cash incentive for facility-based VCT. G4 represents those who are in the control group. Controls include age dummies, sex, marital status, religion, education, employment status, area of residence, household asset ownership (indicators for ownership of land, electricity, radio, television, mobile phone, and a measure of scaled livestock units). The first column includes control and village fixed effects, and the second column includes, in addition, round fixed effects. Robust standard errors clustered at household level are in parentheses.
*Significant at 10%; **Significant at 5%; ***Significant at 1%.

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Table VI. Baseline characteristics by testing status

	Obs (1)	Home Refusal (2)	Home test takers (3)	CCT Refusal (4)	CCT test takers (5)	Home vs CCT (6)	Home test takers vs. CCT test takers (7)	Home refusal vs. CCT refusal (8)
Panel A.								
Individual characteristics								
Number of individuals	1484	210	540	198	536			
Age	1484	31.481	32.585	30.419	32.017	0.690	0.568	1.062
Men	1484	0.571	0.500	0.601	0.481	0.006	0.019	−0.030
Married	1484	0.700	0.793	0.646	0.817	−0.004	−0.025	0.054
Engaged in economic activity	1,484	0.838	0.781	0.798	0.806	−0.006	−0.024	0.040
Had formal education	1484	0.890	0.844	0.894	0.875	−0.023	−0.031	−0.003
Illiterate	1484	0.248	0.365	0.232	0.392	−40.017	−0.027	0.015
Religion								
Orthodox Christian	1484	0.662	0.624	0.646	0.560	0.052**	0.064**	0.015
Muslim	1484	0.324	0.356	0.338	0.427	−0.057**	−0.072**	−0.015
Satisfied with health status	1481	0.852	0.849	0.853	0.880	−0.002	−0.003	0.000
HIV/AIDS-related knowledge score	1484	0.646	0.648	0.658	0.626	0.012	0.022	−0.012
Know HIV testing center	1484	0.629	0.598	0.662	0.612	−0.019	−0.014	−0.033
Have a regular sex partner	1290	0.886	0.899	0.894	0.918	−0.017	−0.019	−0.009
Unsafe sex (Not used condom in last sex)	1342	0.763	0.851	0.842	0.864	−0.033	−0.014	−0.080
Relationship with last sexual partner								
Spouse/fiance/ cohabiting partner	1288	0.949	0.956	0.865	0.952	0.024*	0.004	0.084***
Non live-in boyfriend or girlfriend	1288	0.045	0.032	0.104	0.033	−0.016	−0.002	−0.059**
Casual acquaintance or commercial sex worker	1288	0.006	0.011	0.031	0.013	−0.008	−0.002	−0.025*
Panel B.								
Household characteristics								
Number of household	863	121	312	127	303			
Area of residence: rural	863	0.876	0.931	0.848	0.933	−0.001	−0.002	0.028
Came from another area	824	0.174	0.136	0.142	0.134	−0.006	0.001	0.032
Own land	863	0.900	0.931	0.889	0.936	−0.013	−0.005	0.011
Own ox(en)	824	1.713	1.560	1.760	1.613	0.006	−0.052	−0.047
Own electricity	863	0.357	0.241	0.293	0.257	0.007	−0.016	0.064
Own radio	863	0.800	0.729	0.808	0.749	−0.007	−0.020	−0.008
Own television	863	0.076	0.041	0.111	0.051	−0.010	−0.010	−0.035

Notes: The table reports means of selected baseline variables. 'Home' group includes individuals offered home testing during first-round experiment (Group 2) and those offered home testing during the second experiment (half of the sample in Group 1 and control group). Similarly, 'CCT' group includes individuals offered cash incentives during first-round experiment (Group 3) and those offered cash incentives during the second-round experiment (half of the sample in Group 1 and control group). Columns 2–5 show summaries for the sample assigned to home testing and conditional cash transfer (CCT) during first and second-round experiment by test take-up status. Columns 6–8 report mean differences (and significance levels) between research groups offered different incentives but have identical test take-up status. *Significant at 10%; **Significant at 5%; ***Significant at 1%.

(Columns 1 and 2). Moreover, we find similar results during both first-round and the second-round experiments (Columns 3 and 4). However, this should be interpreted with caution because of the relatively small number of HIV-positive cases in our sample.[27]

To shed more light on this and examine possible self-selection based on incentive type, we compare the characteristics of test takers and non-takers under the two options.[28] Table VI presents the baseline characteristics of non-testers and testers under home-based VCT (Columns 2 and 3) and under CCT for facility-based VCT

[27]We have only 15 positives from home testing and three positives from CCT.

[28]The characteristics we examine are those of individuals offered incentives for the first time (Groups 2 and 3 during the first-round experiment and Groups 1 and 4 during the second-round experiment).

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(Columns 4 and 5), respectively.[29] Column 6 compares the characteristics of those offered home-based VCT with those offered CCT for facility-based VCT. Because the type of incentive was randomly offered, we expect and confirm a balance between the two groups, except for religion. Column 7 compares home-based test takers with facility-based test takers, and Column 8 compares home-based non-takers with facility-based non-takers. Any difference between Columns 7 and 8 should be driven by a sorting that home testing and CCT attract people with different characteristics. Column 8 shows that the last sexual partner of those who refuse home-based VCT is more (less) likely to be a spouse or cohabiting partner (a non-live-in boyfriend or girlfriend, a casual acquaintance, or a commercial sex worker). We discuss this finding further in the next section.

5. DISCUSSION

In the health belief model, health information could change behavior by affecting individuals' (perceived) severity of a health problem, their (perceived) susceptibility to the problem, the (perceived) benefits of trying to avoid the problem, and (perceived) barriers to taking an action. Although the health belief model predicts that a comprehensive HIV education cannot only improve knowledge on HIV/AIDS but also affect demand for VCT, we find that HIV/AIDS education has a limited effect on improving demand for HIV testing even though door-to-door HIV education has improved HIV/AIDS knowledge for 3 to 6 months. On the other hand, we find a significantly higher test take-up when HIV education is combined with home-based VCT (which effectively eliminates the physical barriers) or cash incentives for facility-based VCT (which minimize the costs of visiting a testing clinic). These findings suggest that physical and financial barriers are the main barriers that curb demand for HIV testing.

We also find evidence of the persistency of HIV testing where HIV testing in the past and HIV testing in the future are neither complements nor substitutes, on average. Further, we find no evidence of a higher likelihood of HIV testing among individuals who had unprotected sex during their last sexual encounter, although we note that self-reported condom use may be an imperfect proxy for risky sexual behavior. For example, one may not use a condom if he or she is convinced that his or her partner is unlikely to have contracted STIs including HIV, and demand for HIV testing could also be low among this type of individuals. In addition, self-reported condom use may not be an ideal measure of risky behavior because of reporting bias. Indeed, previous studies (Råssjö *et al*., 2011; Taha *et al*., 1996) have shown that self-reported condom use is not strongly correlated with STIs. Therefore, further research is needed on the link between the demand for HIV testing and the riskiness of sexual encounters using bio-markers (as opposed to self-reported data) to provide a solid evidence.

Lastly, we find suggestive evidence that home-based testing could be more effective at detecting HIV-positive cases than cash incentives for a facility-based testing.[30] We provide a potential mechanism through which home testing could detect more HIV-positive cases. Specifically, we find that those who refuse home-based VCT are less likely to engage in sex with a non-live-in boyfriend or girlfriend, a casual acquaintance, or a commercial sex worker. This finding suggests that facility-based VCT is a less preferred option to home-based VCT by people with a higher chance of HIV infection. This might be caused by spousal pressure on those individuals displaying risky sexual behaviors or by home-based VCT providing a more convenient environment to individuals with risky sexual encounters. Another potential explanation is that those with HIV are less likely to be sufficiently healthy to go to the assigned clinic, often taking a few hours on foot. However, we find that the subjective health status of home-based testers is not different from that of facility-based testers.

Finally, we would like to note that the number of HIV-positive testers in our sample is quite small, and the study was not designed to detect statistically significant differences (between home-based and facility-based VCT) in the number of detected HIV-positive cases. Therefore, additional studies need to be conducted to

[29] The 'home' group includes Group 2 and those that received a home testing offer in the second intervention among Group 1 and the control group. Similarly, the 'CCT' group includes Group 3 and those that received a CCT for HIV testing offer in the second intervention among Group 1 and control group.

[30] This finding contrasts with those presented by Menzies et al. (2009), where the highest HIV-positive rate is found among facility-based HIV testers in Uganda relative to testers under door-to-door VCT. However, this study is not an RCT and thus only shows a correlation between HIV testing strategy and HIV status.

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provide accurate evidence of the effectiveness of different VCT delivery options in identifying HIV infections. We would also like to highlight that given the setting in which the fieldwork was carried out (relatively low risk and low HIV prevalence), our findings may not be generalizable to other (high risk and high prevalence) settings where test take-up may be less responsive to incentives.

6. CONCLUSION

HIV/AIDS poses a major development and health policy challenge, and VCT is considered to be an important prevention strategy in the fight against the AIDS epidemic. In spite of improvements in the testing rate and access to ART, VCT take-up is still low in many developing countries impacted by the epidemic. Limited awareness about the need for and benefits of testing, limited access to testing services, fear of stigma and discrimination, and limited access to HIV treatments are among the factors that are believed to contribute to the low testing take-up.

We implement a RCT to examine the causal effects of HIV/AIDS education and incentives for HIV testing on HIV/AIDS knowledge and demand for HIV testing in rural Ethiopia. We find that although door-to-door HIV/AIDS education significantly increases the level of HIV/AIDS knowledge, it increases test take-up to a limited extent. However, when HIV/AIDS education is combined with home-based VCT or cash incentives for facility-based VCT, take-up increases substantially. Although the test take-up rate is similar under both home-based and cash incentives for facility-based VCT, we find suggestive evidence that home-based VCT could be more effective at detecting HIV-positive cases than facility-based VCT. We also demonstrate evidence of persistence in test-taking behavior. While it is unclear how repeated testing affects infection expectation and behaviors in the long run, we show that prior test taking does not dampen demand for future testing.

Our findings highlight the importance of geographic accessibility in the testing decision and persistence in demand for HIV testing. They also highlight the need for accompanying HIV testing promotion campaigns with simultaneous efforts to improve access to VCT services to achieve the goal of universal access to HIV counseling and testing.

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