Incentivizing safe sex: A randomized trial of conditional cash transfers for HIV and sexually transmitted infection prevention in rural Tanzania

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Abstract

Objective  We evaluated the use of conditional cash transfers as an HIV and sexually transmitted infection prevention strategy to incentivize safe sex.

Design  An unblinded, individually randomised and controlled trial

Setting  10 villages within the Kilombero/Ulanga districts of the Ifakara Health and Demographic Surveillance System in rural south-west Tanzania.

Participants  We enrolled 2399 participants, aged 18-30 including adult spouses.

Interventions  Participants were randomly assigned to either a control arm (n=1,124) or one of two intervention arms: low-value conditional cash transfer (eligible for $10 per testing round, n=660) and high-value conditional cash transfer (eligible for $20 per testing round, n=615). We tested participants every 4 months over a 12 month period for the presence of common sexually-transmitted infections. In the intervention arms, conditional cash transfer payments were tied to negative sexually transmitted infection test results. Anyone testing positive for a sexually transmitted infection was offered free treatment, and all received counseling.

Main outcome measures  The primary study endpoint was combined prevalence of the four sexually transmitted infections which were tested and reported to subjects each four months: *Chlamydia trachomatis, Neisseria gonorrhoeae, Trichomonas vaginalis, and Mycoplasma genitalium*. We also tested for HIV, Herpes simplex virus2, and syphilis at baseline and month 12.

Results  At the end of the 12 month period, for the combined prevalence of any of the four sexually transmitted infections which were tested and reported each four months (*Chlamydia trachomatis, Neisseria gonorrhoeae, Trichomonas vaginalis, and Mycoplasma genitalium*), unadjusted relative risk for the high-value conditional cash transfer arm compared to controls


was 0.80 (95% C.I.: 0.54 to 1.06) and the adjusted relative risk was 0.73 (95% C.I.: 0.47 to 0.99). Unadjusted relative risk for the high-value conditional cash transfer arm compared to the low-value conditional cash transfer arm was 0.76 (95% C.I.: 0.49 to 1.03) and the adjusted relative risk was 0.69 (95% C.I.: 0.45 to 0.92). No harm was reported.

**Conclusions**  Conditional cash transfers used to incentivize safer sexual practices are a potentially promising new tool in HIV and sexually transmitted infections prevention. Additional larger study would be useful to clarify the effect size, to calibrate the size of the incentive, and to determine whether the intervention can be delivered cost effectively.

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Introduction

Innovative solutions for AIDS prevention are desperately needed. The Joint United Nations Programme on HIV/AIDS reported that five people are infected for every two placed on treatment, and, in 2009, approximately 2.8 million people were newly infected\(^1\). Large-scale behavior change interventions aimed at promoting safer sexual practices have proven less effective and more unreliable at stemming the tide of the epidemic than hoped\(^2,3\). It has been far more difficult than was first anticipated to persuade high risk populations to adopt safer sexual behaviors and practices that serve their longer term interests.

Conditional cash transfer programs have become an increasingly popular approach for incentivizing socially desirable behavioral change\(^4\). The principle of conditionality – making payments contingent, for example, on a minimal level of schooling attendance or preventative care use – distinguishes conditional cash transfer programs from more traditional means tested social programs. The evaluation of conditional cash transfer programs have shown that they can be effective at raising consumption, education, and preventative health care,\(^5\) as well as actual health outcomes\(^6\). Similarly, “contingency management” approaches have shown important substance abuse reductions by conditioning rewards on negative tests for drug or alcohol use\(^7\).

In the context of the staggering social, economic, and human costs of the AIDS epidemic in Sub-Saharan Africa, it is perhaps not as great a leap as it would first appear to apply the logic of conditional cash transfers to the private arena of human sexuality with the aim of incentivizing safer sexual practices among high risk populations. Numerous studies have documented the responsiveness of sexual behavior to incentives, such as sex workers willing to forego condoms
when clients pay extra\textsuperscript{8}, and increases in transactional sex in the face of household financial difficulties.\textsuperscript{9} Economic theory suggests several pathways through which risky sexual behaviors could be reduced by a conditional cash transfer program that conditions payment on negative sexually transmitted infections tests. Standard theory predicts that the incentives could operate by raising the implicit price of unsafe sex (risking losing the conditional cash transfer), or by bringing the rewards of risk avoidance much closer to the present (e.g. a conditional cash transfer within weeks may be more powerful for some people than the specter of developing AIDS many years in the future), or both. If the conditional cash transfer was sufficiently large then this higher income could also relieve economic pressures on young women to engage in transactional sex; but even if incentives were small, recent behavioral economics research suggests that regular reminders of this new frame for viewing sexual behavior could still “nudge” individuals to overcome inertia and extricate themselves from unduly risky sexual relationships\textsuperscript{10}. In Malawi, small financial incentives have already been shown to increase the uptake of HIV testing and counseling\textsuperscript{11}. In the only prior study similar to ours, a follow-on Malawi intervention promised a single cash reward in one year’s time for individuals who remained HIV negative, but this design had no measurable effect on HIV status.\textsuperscript{12} By contrast, we used the above theory to design and evaluate a novel intervention that tests for risky sexual behavior repeatedly over shorter time intervals, reinforcing learning about safer behavior with conditional cash transfer incentives each time.

**Methods**

**Trial design**
This study is an unblinded, individually randomised and controlled trial. It has three separate arms – a control arm with an allocation ratio of 50% and two intervention arms (low-value conditional cash transfer and high-value conditional cash transfer) with an allocation ratio of 25% each. No important changes to methods were implemented after trial commencement.

**Participants**

Inclusion criteria consisted of males and females, aged 18-30 (and spouses starting at age 16 and potentially older than 30), residing in one of 10 study villages within the Kilombero/Ulanga districts of the Ifakara Health and Demographic Surveillance System\(^\text{13}\) in south-west Tanzania. The villages consisted of 8 rural villages and 2 semi-urban neighborhoods in Ifakara town, with participants evenly distributed across the villages. On average across the 10 villages approximately 20% of the 18-30 old residents were enrolled in the study. There were three exclusion criteria: being pregnant at the time of registration, having the intention to permanently migrate out of the Ifakara Health and Demographic Surveillance System area within the next year, and unwillingness to participate if assigned to the control arm. HIV-positives were eligible for enrollment.

**Interventions**

The intervention arm was divided into two sub-arms – a low-value conditional cash transfer arm eligible for up to $30 over the course of the study (10,000 Tanzanian shillings or approximately $10 per testing round), and a high-value conditional cash transfer arm eligible for up to $60 (20,000 Tanzanian shillings or approximately $20 per testing round). Those amounts were determined based on focus-group discussions in neighboring villages conducted before the intervention started, balancing sufficient incentive levels against concerns about scalability and
potential coercion. All participants were tested for sexually transmitted infections at baseline and then every 4 months for one year. Participants in the two intervention arms were eligible to receive conditional cash transfer incentive payments if they tested negative for curable sexually transmitted infections at the 4, 8, and 12-month testing rounds. Sexually transmitted infections tested at all of these incentivized rounds were *Chlamydia trachomatis*, *Neisseria gonorrhoea*, *Trichomonas vaginalis*, and *Mycoplasma genitalium*, which are transmitted through unprotected sexual contact and therefore serve as a proxy for risky sexual behavior as well as vulnerability to HIV infection\textsuperscript{14,15,16,17}.

Individuals in the conditional cash transfer arms were not eligible for the cash award at the 4, 8, and 12-month testing rounds if they tested positive for any of the following: *Chlamydia trachomatis*, *Neisseria gonorrhoea*, and *Trichomonas vaginalis*. Those converting from negative at baseline to positive at 12-months for syphilis or herpes Simplex Virus 2 were also ineligible to receive the 12-month conditional cash transfer. HIV testing was conducted at baseline and month 12, but payments were not conditioned on those results because of local ethical sensitivities. *Mycoplasma genitalium* results did not affect conditional cash transfer eligibility because there is some uncertainty around transmission pathways, however it was included in the combined prevalence measure used as primary outcome to increase statistical power. Individuals in the intervention arms testing positive for any of the conditioned curable sexually transmitted infections did not receive the conditional cash transfer, but were eligible to continue as a study participant in subsequent rounds after having been treated and cured of the infection. Individuals in the control arm were not eligible for conditional cash transfer, but all other study procedures were identical between the control and intervention arms. Anyone testing positive for a sexually transmitted infection (regardless of arm) was offered counseling and free sexually transmitted
infection treatment (for self and partners) through health facilities of the District Ministry of Health serving the research communities. Individual pre-test and post-test counseling was provided to study enrollees at each testing interval, following Tanzania national testing guidelines. In addition, monthly group counseling sessions emphasizing relationship-skills training adapted from a sub-set of the Stepping Stones curriculum, were also made available to all study participants in all villages, but were not mandatory.

Outcomes

The biological markers used in the study were selected both due to their likely prevalence levels in the study population and due to their status within the epidemiological literature as reasonable proxies for risky sexual behavior. The primary outcome measure, as defined in the study protocol, is the round-specific combined point prevalence of the four sexually transmitted infections that were regularly tested – *Chlamydia trachomatis*, *Neisseria gonorrhoea*, *Trichomonas vaginalis*, and *Mycoplasma genitalium* – at months 4, 8, and 12. This measure of combined point prevalence was constructed at study design to ensure sufficient power to detect differences in the control and treatment groups in response to the conditional cash transfer intervention. For logistical reasons, *Mycoplasma genitalium* testing was not conducted at baseline. We also tested for HIV, herpes simplex virus2, and syphilis at baseline and month 12.

All sexually transmitted infection testing was conducted by the Ifakara Health Institute microbiology laboratory in Ifakara. All test results were available within 7-10 days and were returned to participants the following week. Ten percent of all samples, and all positives, were sent to the University of California Chlamydia Laboratory for confirmation analysis (quality control).
Specimens for chlamydia, gonorrhea, trichomonas, and *Mycoplasma genitalium* were collected by a self-administered vaginal swab for females. Males provided a “first-catch urine” (about 20-30 mL) sample. Specimen collection among females was always observed by a nurse at the testing station. For males, the specialized receptacle used to collect a urine sample was provided only after dropping off personal belongings upon checking in to the testing section of the study station. Males were asked to urinate into the study receptacle in the vicinity of the study station. Detection used GenProbe Aptima (GenProbe Inc, San Diego, CA) nucleic acid amplification tests.

To test for HIV, herpes simplex virus2, and syphilis, a single venous blood sample of approximately 5-10 mL was collected from each participant at baseline and month 12. For herpes simplex virus2, we used the Focus HerpeSelect HSV-2 ELISA IgG assay (Focus Technologies, Cypress, CA) to detect serum antibodies. *T. pallidum* was identified using rapid plasma reagin with reactive tests confirmed by treponema pallidum particle agglutination assay. Active syphilis was defined as rapid plasma reagin+/treponema pallidum particle agglutination assay+. For HIV, we used a series of three rapid tests for screening results (SD Bioline HIV-1/2 3.0, Standard diagnostics, INC. Kyonggi-do, Korea), confirmation of positives (Determine® HIV-1/2, Inverness Medical Japan Co., Ltd), and tie-breaking (Uni-Gold™ HIV, Trinity Biotech plc. Bray, Ireland).

**Sample size**

Early study planning had initially assumed a sample size of 3000, which would have provided improved power for gender subgroup analysis in our main comparisons, but due to logistical fieldwork constraints the recruited sample size was reduced to approximately 2400. We present
here the ex-post power calculations at this actual recruited sample size and actual infection rates, based on a comparison of combined sexually transmitted infection prevalence rates of 12% between two, equal-sized study arms for a single post-treatment measurement of proportions controlling for one baseline measure, and assuming a two-sided alternative hypothesis. We calculated that a total sample size of 2400 individuals would be sufficient to provide at least 90% power to detect a one-third intervention-related reduction in sexually transmitted infection point prevalence (significant at the 5% level) in both intervention arms combined. This sample size would also retain at least 80% power to detect a reduction in a single intervention arm (e.g. the high value conditional cash transfer arm) compared to the control arm, and if the prevalence was assumed to be as high as 20% then this power rises to over 90%. Subgroup analysis by gender would not be powered at the 80% level for our main comparison of the high value conditional cash transfer arm against controls assuming a 12% prevalence level, although it would retain approximately 90% power when comparing the combined arms against the control arm assuming 20% prevalence.

**Randomization**

Individual-level randomization took place at the study station after baseline interview and testing, with participants selecting colored balls from an opaque bag. The randomization took place in public view and in two stages with participants first randomly selecting one of four balls to determine their allocation to the intervention or the control arm. In order to study potential peer-effects, in randomly selected sub-villages, the probably of selection in the intervention arm was 75% (3 balls out of 4) and in the other sub-villages, it was 25% (1 ball out of 4); based on the distribution of participants across sub-villages, we thus expected 48% of the overall sample to be randomized into the control arm. Participants randomized into the intervention arm were
further invited to choose one of two balls from a second bag determining in which of the two intervention arms (low-value conditional cash transfers and high-value conditional cash transfers) they would be allocated. These highly transparent procedures were deemed necessary for acceptability of randomization in a population with limited formal education. Participants were not blinded to arm assignment since awareness of their eligibility for the conditional cash transfer was a critical component of the intervention.

Spousal pairs were assigned the same intervention arm and the protocol prescribed for randomization to occur after both spouses had enrolled.

**Statistical methods**

Each individual was coded as per their initial randomized assignment as per an intent-to-treat design. However, individuals who were not present at any given round were treated as missing and dropped from the analysis for that round due to lack of outcome data. We report sample means at baseline to verify the balance across the three study arms. Unadjusted outcomes at the three follow-up rounds are reported using relative risks, i.e. the probability of being positive for any sexually transmitted infection in the intervention arm, divided by the probability of being positive for any sexually transmitted infection in the control arm. Relative risks are calculated from logistic regressions using the `margins` and `nlcom` post-estimation commands in the *Stata 12* statistical software package. We further report adjusted outcomes using relative risks to account for residual variation across arms after randomization. Adjustments have been made for standard socio-economic variables such as gender, education, age, marital status, income, socio-economic status, sub-village and baseline sexually transmitted infection status. Age and income are
continuous variables while the other adjustment variables are categorical. We cluster standard errors both at the household and at sub-village levels, accounting for the possible correlation within couples and the variation in selection probability at that sub-village level. We present a sub-group analysis by gender. We used Stata 12.1 (Stata Corp, College Station, Texas) for statistical analysis.

**Role of the funding source**

The funding sources had no involvement in the design and conduct of the study.

**Results**

**Participant flow**

A total of 5,370 individuals were randomly selected from the Ifakara Health and Demographic Surveillance System sample (Figure 1). 864 (16.1%) of those individuals were not found, 6 (0.1%) had died and 344 (6.4%) had migrated. Fieldworkers assessed for eligibility 4,156 individuals: 173 (4.2%) did not meet the inclusion criteria, among them 35 (0.8%) were not in the study age range and 138 women (3.3%) were currently pregnant. Of those eligible, 133 (3.3%) explicitly refused to participate in the study and 168 (4.2%) declined for other reasons. All others (3,682) were given an invitation to come to a study station the following week: 2,409 (65.4%) registered for the study and were randomized into one of the three study arms, while 1,273 did not come to the study station for registration.

Of the 2,409 registered participants, 1,124 (46.7%) were randomly allocated to the control arm. Among the participants, 1,285 were randomly selected, in a first stage, to one of the two conditional cash transfer arms: 615 (25.5%) were randomly assigned in the high value
conditional cash transfer arm and 660 (27.4%) in the low value conditional cash transfer arm.
Ten (0.4%) individuals assigned to the intervention arms were intentionally dropped from the analysis since they failed to be further randomized in one of the two sub-arms. In the control arm, 967 were tested and interviewed at round 2 (attrition 14%), 983 (attrition 12.5%) at round 3 and 1,039 (attrition 7.6%) at round 4. In the high value conditional cash transfer arm, 570 were tested and interviewed at round 2 (attrition 7.3%), 567 (attrition 7.8%) at round 3 and 585 (attrition 4.9%) at round 4. In the low value conditional cash transfer arm, 568 were tested and interviewed at round 2 (attrition 13.9%), 567 (attrition 14.1%) at round 3 and 618 (attrition 6.4%) at round 4. Overall, attrition was lower at round 4 because the field team made extensive additional effort to contact and interview attriters. Symptomatic individuals in all study arms were particularly encouraged to come to the study station in order to receive free sexually transmitted infection treatment. Attrition was not predicted by any of the baseline sexually transmitted infection results, except that HIV positive individuals at baseline were more likely to be lost to follow-up, despite the fact the participants were clearly told that HIV status would not affect eligibility for conditional cash transfers.

**Recruitment**

Recruitment and baseline data collection took place from February 10 to April 9, 2009. The second, third and fourth rounds of interviews and testing took place from June 9 to August 15, 2009, September 29 and December 5, 2009 and February 16 and May 1st, 2010, respectively. The conditional cash transfer intervention was stopped after one year, following the protocol.

**Process**
The intervention was well accepted and accessed by the study participants as indicated in the participant flow and the low attrition numbers. Further, study participants randomized into the conditional cash transfer arms declared that the financial incentives motivated them to modify their behavior. In the high-value conditional cash transfer arm 317(59.0%) declared that the money motivated them “very much” to change their behavior and 67(12.5%) stated that it motivated them “somewhat”. In the low value conditional cash transfer arm, those numbers are 194(37.4%) for “very much” and 107(20.6%) for “somewhat”.

**Baseline data**

Table 1 describes the baseline characteristics of the participants by study arm. The prevalence of the six STIs tested at baseline was distributed similarly across arms. Participants were also similar according to gender and education. However, individuals in the two intervention arms had slightly lower self-reported socio-economic status, and individuals in the low value conditional cash transfer arm also had a higher income.

We verified that there was no deviation from protocol that could have led to differential secondary spousal enrollment across arms: 604 out of the 2399 participants were spouses who joined the study after their spouse was initially invited. They were distributed as follows: 279 out of 1124 (24.8%) in the control arm, 156 (25.4%) out of 615 in the high value cash arm and 169 (25.6%) out of 660 in the low value cash arm. Tests for statistical differences with the control arm yield p-values of 0.673 for the high conditional cash transfer arm and 0.742 for the low conditional cash transfer arm, so differences across the three study arms in the percentage of spouses joining the study are minimal and not statistically significant.
**Numbers analyzed**

Except for the 10 (0.4%) individuals who failed to be assigned to either the high or low conditional cash transfer arm, all participants tested and interviewed at the respective rounds were included in the analysis (refer to the sample sizes in tables 1 and 2). The reductions in sample size from the unadjusted (table 2) to the adjusted analysis (table 3) were from 2,105 to 2,077 at round 2, from 2,117 to 2,092 at round 3 and from 2,242 to 2,211 at round 4 due to missing data on covariates in the logistic regression model (table 2 results are similar when using the smaller samples from table 3).

**Outcomes and estimation**

Table 2 presents the unadjusted relative risk ratios compared to the control group. At months 4, 8 and 12 when the outcome is the combined point prevalence of the four curable sexually transmitted infections tested every 4 months by nucleic acid amplification tests (columns 1-3), the relative risks are not statistically different at the 5% significance level. At month 12, the number of positives was 57(9.7%) in the high-value conditional cash transfer arm while it was 79(12.8%) in the low-value conditional cash transfer arm and 126(12.1%) in the control group. At month 12, this unadjusted analysis estimated a reduction in the relative risk of those four curable sexually transmitted infections for the high value conditional cash transfer arm of 20% (95% CI: 6% increase to 46% reduction). The relative risks were also not statistically different at the 5% significance level in column 4 for the combination of syphilis prevalence and new cases of HIV and herpes simplex virus 2. Those 3 sexually transmitted infections were detected by serology performed only at baseline and Round 4. For the combined point prevalence of
chlamydia, gonorrhea, trichomonas, Mycoplasma genitalium at month 12, the unadjusted relative risks are not statistically different than 1 at 5% significance level when males and females are considered separately (column 5 and 6). At month 12, for the combined point prevalence of the four curable sexually transmitted infections tested by nucleic acid amplification tests, unadjusted relative risk for the high-value conditional cash transfer arm compared to the low-value conditional cash transfer arm was 0.76 (95% C.I.: 0.49 – 1.03) and was 0.56 (95% C.I.: 0.26 – 0.87) for males only.

Table 3 presents results from adjusted regressions. Adjustments have been made for gender, education, age, marital status, income, socio-economic status, sub-village and baseline sexually transmitted infection status. At months 4 and 8 (columns 1 and 2), the combined prevalence of the four sexually transmitted infections tested by nucleic acid amplification tests is shown to have relative risks lower than one for the two conditional cash transfer arms compared to the control arm, but not significantly so. However, at month 12 (column 3) for the combined prevalence of the sexually transmitted infections tested by nucleic acid amplification tests the adjusted model estimated a 27% reduction in the relative risks for the high value conditional cash transfer arm compared to the control arm (95% C.I.: 1% to 53% reduction), while the relative risk is not statistically different than 1 for the low value conditional cash transfer arm. At month 12, for the 3 sexually transmitted infections detected by serology (without having been tested at months 4 and 8), the relative risk for the low value conditional cash transfer arm is 0.82 (column 4), but is not significantly lower than the control arm (95% C.I.: 0.60 – 1.03). In a subgroup analysis by gender (columns 5 and 6), for the 4 sexually transmitted infections tested by nucleic acid amplification tests, the relative risks for the high value conditional cash transfer
arm are 0.68 for males and 0.76 for females. Those two relative risks are not significantly different from each other (as confirmed by test of interaction between gender and arm, where an interaction term for female was not significant for either conditional cash transfer arm (p-values 0.648 for high value cash transfer arm and 0.391 for low value cash transfer arm), and are not significantly lower than 1 at the 5% level. At month 12, for the combined point prevalence of the four sexually transmitted infections tested by nucleic acid amplification tests, adjusted relative risk for the high-value conditional cash transfer arm compared to the low-value conditional cash transfer arm was 0.69 (95% C.I.: 0.45 – 0.92), and was 0.52 (95% C.I.: 0.23 – 0.80) for males only.

**Discussion**

After 12 months, the adjusted results showed a significant reduction in the combined point prevalence of the four curable sexually transmitted infections tested every 4 months by nucleic acid amplification tests in the group that was eligible for the $20 quarterly payments, but no such reduction was found for the group receiving the $10 quarterly payments. Such results were not found at earlier rounds nor for unadjusted results. Further, the impact of the conditional cash transfers did not differ between males and females.

**Limitation**

Our main outcome measure is the combined point prevalence of four sexually transmitted infections repeatedly tested by nucleic acid amplification tests over the course of the year and which have been incontrovertibly linked to risky sexual activity. These biological outcomes, however, cannot be used to infer the relative importance of sexually transmitted infection
treatment seeking behavior versus other behavior changes such as increased condom use or reducing riskiness of partners. Further, the lack of a clear result on the combined measure for the 3 sexually transmitted infections that were detected by serology only at baseline and month 12, (this measure primarily reflects herpes simplex virus-2 incidence, as HIV and syphilis prevalence were somewhat lower) is puzzling and merits further study. The contrasting result with the impact of the high value conditional cash transfers on the 4 curable sexually transmitted infections that were tested by nucleic acid amplification tests could point to the importance of treatment seeking behavior rather than safer sexual practices. However, the interpretation of herpes simplex virus2 results is complicated by the fact that most transmission occurs via asymptomatic shedding by partners who may be otherwise low-risk\textsuperscript{19}, as well as the fact that it can be transmitted even in the context of appropriate condom use.\textsuperscript{20} Furthermore, this study was not powered to directly examine HIV conversion, thus implications for HIV prevention remain speculative.

In order to study potential peer-effects, in randomly selected sub-villages, the probably of selection in the intervention arm was 75% and in the other sub-villages, it was 25%. This might have led to baseline imbalances. For this reason, we included sub-village indicator variables in the adjusted models. This might explain some of the differences between the results from the unadjusted and the adjusted models.

Finally, the results reported in this study are limited to a 12 month experiment, and cannot address the sustainability of improvements in sexually transmitted infection outcomes over a longer period, particularly after the conditional cash transfers have been discontinued. Nor can they address the possibility of adverse consequences to the extent that extrinsic incentives may reduce long-term intrinsic motivation to engage in safe behaviors after incentives are withdrawn.
To address these questions, we will follow up with study participants one year following the end of the intervention study, in the Spring of 2011, to assess whether improved outcomes have been sustained, or reversed, in the absence of a positive feedback mechanism in the form of sexually transmitted infection testing and conditional cash transfers.

**Generalizability**

While these study results are important in showing that the idea of using financial incentives can be a useful tool for preventing HIV and sexually transmitted infection transmission, it remains an initial study on a limited scale. Even though the study site is fairly representative of rural and small town environments in sub-Saharan Africa, this approach would need to be replicated elsewhere and implemented on a larger scale (in permutations requiring less administrative and laboratory capacity) before it could be concluded that such conditional cash transfer programs offer an efficient, scalable and sustainable HIV prevention strategy.

**Interpretation**

The results indicate that conditional cash transfers based on negative results of periodic screenings for incident sexually transmitted infections – an objectively measured marker for risky sexual behavior – are a potentially useful tool for sexually transmitted infection and possibly HIV prevention. The extraordinarily high social and economic cost of the current HIV and AIDS crisis suggests that prevention can be far cheaper than treatment, thus motivating the continued search for innovative and effective new prevention approaches, such as conditional cash transfers or other financial incentives.

The absence of significant impacts at rounds 2 (month 4) and 3 (month 8) suggest that the impact of the conditional cash transfer may take time to materialize, perhaps because it is not easy to
extricate oneself from complicated sexual relationships, or perhaps because participants needed time to become accustomed to (and trust) the incentive mechanism. The comparison between the impacts of the conditional cash transfer intervention in the high-value conditional cash transfer arm to that in the low-value conditional cash transfer arm permits us to better understand at which threshold conditional cash transfers can be effective as an HIV and sexually transmitted infection prevention tool. While the results showed a significant reduction in sexually transmitted infection incidence in the arm that was eligible for the $20 conditional cash transfers every 4 months or up to $60 over 12 months, no such reduction was found for the arm receiving the $10 conditional cash transfers every 4 months or up to $30 over 12 months. This distinction must be interpreted with caution though because assignments were not masked hence individuals in the low value conditional cash transfer arm could have behaved differently than if they were to receive the same incentive in the absence of a higher conditional cash transfer arm. Both of these amounts represent a meaningful proportion of household income in a country where gross domestic product per capita was $440 in 2008, and particularly among our study participants who had mean individual annual earnings of approximately $250.

Other information

Registration

This randomized control trial is registered at ClinicalTrials.gov, study identifier # NCT00922038

Protocol

The study protocol was initially approved by the University of California; Berkeley's institutional review board (Committee for Protection of Human Subjects) effective December 17, 2008; approval has been updated numerous times since to reflect protocol amendments, with the

**Contributors**

DdW, WHD, RN and CAM made contributions to each part of the project, planned and designed the study, conducted the analysis, interpreted the findings, and contributed to the manuscript. The Ifakara Health Institute was the main implementing agency for the project: BJ and FA managed the Ifakara laboratory testing, AM led field operations, MAM facilitated operations, KS programmed the study systems and together with RA managed the database and SM was responsible for outreach to participating communities and health clinics. EG contributed to data analysis, LP conducted in-depth interviews, and ZI was Project Director on-site in Tanzania. From UCSF, JM and JS set up the IHI laboratory, developed lab protocols, and were responsible for quality control. SK, JJ, and EM as senior investigators have contributed throughout the project and are leading sub-analyses linked to the main study in their respective fields of expertise. All authors, external and internal, had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. DdW and WHD are the guarantors of the study. Data sharing: no additional data available.

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**Conflict of interest statement**

All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare that they and their spouses, partners, or children have no financial or non-financial interests that may be relevant to the submitted work.

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The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction
and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.
Summary points box

What is already known on this topic?

- Existing prevention strategies have had a limited impact on the trajectory of the HIV/AIDS epidemic.
- Conditional cash transfers have been used successfully in a variety of settings to promote activities that are beneficial to the participants such as school participation or health check-ups for children.

What this study adds?

- This trial asks whether conditional cash transfers can be used to prevent people from engaging in activities that are harmful to themselves and others, such as unsafe sex.
- After 12 months, the results from the adjusted model showed a significant reduction in the combined point prevalence of the four curable sexually transmitted infections tested every 4 months by nucleic acid amplification tests in the group that was eligible for the $20 payments, but no such reduction was found for the group receiving the $10 payments.
- The results suggest that conditional cash transfers used to incentivize safer sexual practices are a potentially promising new tool in HIV and sexually transmitted infections prevention. Additional larger study would be useful to clarify the effect size, to calibrate the size of the incentive, and to determine whether the intervention can be delivered cost effectively.
Table 1: Summary statistics at baseline, by arm

<table>
<thead>
<tr>
<th>Variables</th>
<th>Control</th>
<th>High Value CCT</th>
<th>Low Value CCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>561 (49.9%)</td>
<td>314 (51.1%)</td>
<td>329 (49.9%)</td>
</tr>
<tr>
<td>Age</td>
<td>27.2 (5.6)</td>
<td>27.6 (5.4)</td>
<td>27.56 (5.7)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>139 (12.4%)</td>
<td>70 (11.4%)</td>
<td>79 (12.0%)</td>
</tr>
<tr>
<td>Primary</td>
<td>863 (76.8%)</td>
<td>482 (78.4%)</td>
<td>660 (78.3%)</td>
</tr>
<tr>
<td>Secondary</td>
<td>122 (10.9%)</td>
<td>63 (10.2%)</td>
<td>64 (9.7%)</td>
</tr>
<tr>
<td>Married</td>
<td>842 (75.0%)</td>
<td>474 (77.1%)</td>
<td>476 (72.7%)</td>
</tr>
<tr>
<td>Low SES</td>
<td>582 (51.8%)</td>
<td>344 (55.9%)</td>
<td>377 (57.2%)</td>
</tr>
<tr>
<td>Yearly income</td>
<td>239,311 (425,091)</td>
<td>257,017 (531,370)</td>
<td>283,218 (534,399)</td>
</tr>
<tr>
<td>Chlamydia</td>
<td>21 (1.9%)</td>
<td>15 (2.4%)</td>
<td>16 (2.4%)</td>
</tr>
<tr>
<td>Gonorrhea</td>
<td>8 (0.7%)</td>
<td>8 (1.3%)</td>
<td>6 (0.9%)</td>
</tr>
<tr>
<td>Trichomonas</td>
<td>130 (11.6%)</td>
<td>88 (14.3%)</td>
<td>79 (12.0%)</td>
</tr>
<tr>
<td>HSV2</td>
<td>380 (33.9%)</td>
<td>226 (36.8%)</td>
<td>225 (34.2%)</td>
</tr>
<tr>
<td>Syphilis</td>
<td>17 (1.5%)</td>
<td>8 (1.3%)</td>
<td>15 (2.3%)</td>
</tr>
<tr>
<td>HIV</td>
<td>41 (3.7%)</td>
<td>17 (2.8%)</td>
<td>27 (4.1%)</td>
</tr>
<tr>
<td>N =</td>
<td>1124</td>
<td>615</td>
<td>660</td>
</tr>
</tbody>
</table>

Data are means (SD) or numbers (%). Yearly income in Tanzanian Shillings (Tsh). At baseline, 1,000 Tsh = approximately 1USD. Low SES corresponds to the lowest two ranks on a self-reported socio-economic status scale from 1 to 7.
### Table 2: Unadjusted outcomes: Relative risk from logistic regression

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Month 4 combined prevalence of 4 STIs tested by NAAT (i)</td>
<td>Month 8 combined prevalence of 4 STIs tested by NAAT (i)</td>
<td>Month 12 combined prevalence of 4 STIs tested by NAAT (i)</td>
<td>Month 12 combined measure for 3 STIs detected by serology at baseline and month 12 (ii)</td>
<td>Month 12 combined prevalence of 4 STIs tested by NAAT (i)</td>
<td>Males only Females only</td>
</tr>
<tr>
<td>High value CCT</td>
<td>1.06</td>
<td>0.86</td>
<td>0.80</td>
<td>1.09</td>
<td>0.70</td>
<td>0.85</td>
</tr>
<tr>
<td></td>
<td>[0.74 to 1.38]</td>
<td>[0.60 to 1.12]</td>
<td>[0.54 to 1.06]</td>
<td>[0.76 to 1.43]</td>
<td>[0.34 to 1.07]</td>
<td>[0.55 to 1.15]</td>
</tr>
<tr>
<td>Low value CCT</td>
<td>0.97</td>
<td>0.80</td>
<td>1.05</td>
<td>1.03</td>
<td>1.25</td>
<td>0.94</td>
</tr>
<tr>
<td></td>
<td>[0.66 to 1.28]</td>
<td>[0.55 to 1.04]</td>
<td>[0.75 to 1.35]</td>
<td>[0.71 to 1.35]</td>
<td>[0.73 to 1.77]</td>
<td>[0.62 to 1.25]</td>
</tr>
<tr>
<td>Number positive</td>
<td>246(11.7%)</td>
<td>260(12.3%)</td>
<td>262(11.7%)</td>
<td>232(10.4%)</td>
<td>99(9.0%)</td>
<td>163(14.3%)</td>
</tr>
<tr>
<td>N</td>
<td>2105</td>
<td>2117</td>
<td>2242</td>
<td>2241</td>
<td>1105</td>
<td>1137</td>
</tr>
</tbody>
</table>

**Number positives by study arm**

<table>
<thead>
<tr>
<th></th>
<th>Control arm</th>
<th>High value CCT</th>
<th>Low value CCT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>112(11.6%)</td>
<td>70(12.3%)</td>
<td>64(11.3%)</td>
</tr>
<tr>
<td></td>
<td>133(13.5%)</td>
<td>66(11.6%)</td>
<td>61(10.8%)</td>
</tr>
<tr>
<td></td>
<td>126(12.1%)</td>
<td>57(9.7%)</td>
<td>79(12.8%)</td>
</tr>
<tr>
<td></td>
<td>104(10.0%)</td>
<td>64(11.0%)</td>
<td>64(10.4%)</td>
</tr>
<tr>
<td></td>
<td>47(9.0%)</td>
<td>18(6.4%)</td>
<td>34(11.3%)</td>
</tr>
<tr>
<td></td>
<td>79(15.2%)</td>
<td>39(12.9%)</td>
<td>45(14.2%)</td>
</tr>
</tbody>
</table>

(i) Chlamydia, gonorrhea, trichomonas, mycoplasma genitalium
(ii) HIV, HSV-2, syphilis

Robust standard errors in parentheses, clustered at both the household and the sub-village levels. 95% confidence intervals in square brackets. The reference group for the computation of the relative risks is the control group.
Table 3: Adjusted outcomes: Relative risk from logistic regression

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Month 4 combined prevalence of 4 STIs tested by NAAT (i)</td>
<td>Month 8 Combined prevalence of 4 STIs tested by NAAT (i)</td>
<td>Month 12 combined prevalence of 4 STIs tested by NAAT (i)</td>
<td>Month 12 combined measure for 3 STIs detected by serology at baseline and month 12 (ii)</td>
<td>Month 12 combined prevalence of 4 STIs tested by NAAT (i)</td>
<td>Month 12 combined prevalence of 4 STIs tested by NAAT (i)</td>
</tr>
<tr>
<td>High value CCT</td>
<td>0.92</td>
<td>0.90</td>
<td>0.73</td>
<td>1.03</td>
<td>0.68</td>
<td>0.76</td>
</tr>
<tr>
<td></td>
<td>[0.62 to 1.20]</td>
<td>[0.61 to 1.18]</td>
<td>[0.47 to 0.99]</td>
<td>[0.74 to 1.32]</td>
<td>[0.25 to 1.10]</td>
<td>[0.46 to 1.07]</td>
</tr>
<tr>
<td>Low value CCT</td>
<td>0.94</td>
<td>0.85</td>
<td>1.06</td>
<td>0.82</td>
<td>1.31</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>[0.63 to 1.26]</td>
<td>[0.58 to 1.13]</td>
<td>[0.75 to 1.38]</td>
<td>[0.60 to1.03]</td>
<td>[0.73 to 1.89]</td>
<td>[0.63 to 1.33]</td>
</tr>
<tr>
<td>Number positive (%)</td>
<td>242(11.7%)</td>
<td>258(12.3%)</td>
<td>257(11.6%)</td>
<td>227(10.3%)</td>
<td>98(9.00%)</td>
<td>159(14.2%)</td>
</tr>
<tr>
<td>N</td>
<td>2077</td>
<td>2092</td>
<td>2211</td>
<td>2210</td>
<td>1093</td>
<td>1118</td>
</tr>
</tbody>
</table>

(i) Chlamydia, gonorrhea, trichomonas, mycoplasma genitalium
(ii) HIV, HSV-2, syphilis

Results adjusted for gender, education, age, marital status, income, SES, sub-village and baseline STIs. Robust standard errors in parentheses, clustered at both the household and the sub-village levels. 95% confidence intervals in square brackets. The reference group for the computation of the relative risks is the control group.


