Promoting male partner HIV testing and safer sexual decision making through secondary distribution of self-tests by HIV-negative female sex workers and women receiving antenatal and post-partum care in Kenya: a cohort study

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Summary

Background Increased uptake of HIV testing by men in sub-Saharan Africa is essential for the success of combination prevention. Self-testing is an emerging approach with high acceptability, but little evidence exists on the best strategies for test distribution. We assessed an approach of providing multiple self-tests to women at high risk of HIV acquisition to promote partner HIV testing and to facilitate safer sexual decision making.

Methods In this cohort study, HIV-negative women aged 18–39 years were recruited at two sites in Kisumu, Kenya: a health facility with antenatal and post-partum clinics and a drop-in centre for female sex workers. Participants gave informed consent and were instructed on use of oral fluid based rapid HIV tests. Participants enrolled at the health facility received three self-tests and those at the drop-in centre received five self-tests. Structured interviews were conducted with participants at enrolment and over 3 months to determine how self-tests were used. Outcomes included the number of self-tests distributed by participants, the proportion of participants whose sexual partners used a self-test, couples testing, and sexual behaviour after self-testing.

Findings Between Jan 14, 2015, and March 13, 2015, 280 participants were enrolled (61 in antenatal care, 117 in post-partum care, and 102 female sex workers); follow-up interviews were completed for 265 (96%). Most participants with primary sexual partners distributed self-tests to partners: 53 (91%) of 58 participants in antenatal care, 91 (86%) of 106 in post-partum care, and 64 (75%) of 85 female sex workers. 82 (81%) of 101 female sex workers distributed more than one self-test to commercial sex clients. Among self-tests distributed to and used by primary sexual partners of participants, couples testing occurred in 27 (51%) of 53 in antenatal care, 62 (68%) of 91 from post-partum care, and 53 (83%) of 64 female sex workers. Among tests received by primary and non-primary sexual partners, two (4%) of 53 tests from participants in antenatal care, two (2%) of 91 in post-partum care, and 41 (14%) of 298 from female sex workers had positive results. Participants reported sexual intercourse with 235 (62%) of 380 sexual partners who tested HIV-negative, compared with eight (18%) of 45 who tested HIV-positive (p<0·0001); condoms were used in all eight intercourse events after positive results compared with 104 (44%) after of negative results (p<0·0018). Four participants reported intimate partner violence as a result of self-test distribution: two in the post-partum care group and two female sex workers. No other adverse events were reported.

Interpretation Provision of multiple HIV self-tests to women at high risk of HIV infection was successful in promoting HIV testing among their sexual partners and in facilitating safer sexual decisions. This novel strategy warrants further consideration as countries develop self-testing policies and programmes.

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Introduction

About half of HIV-positive individuals in sub-Saharan Africa are unaware of their serostatus.[1] Increasing the uptake of HIV testing among these individuals is essential to ensure the success of HIV treatment as prevention and to meet the UNAIDS 90-90-90 targets. Although wider availability of facility-based HIV testing and counselling services and community-based HIV testing and counselling strategies have helped to increase testing coverage,[2,3] achieving high levels of testing coverage has proven challenging in many countries. Men in particular are far less likely to test than are women.[1] There is also a dearth of HIV testing and counselling interventions targeted to key populations such as female sex workers, who can benefit from regular repeat testing.[3] Couples testing is particularly rare, even though it can have substantial health effects through improved sexual decision making and increased antiretroviral therapy (ART) use to prevent HIV transmission.[4,5]

HIV self-testing is a promising approach that has the potential to substantially increase access to testing for individuals and couples in a manner that is confidential and empowering for users.[6,7] Rapid testing technologies include simple-to-use oral HIV tests that offer high sensitivity and specificity, ideal for HIV self-testing strategies. Previous studies have documented high

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Research in context

Evidence before this study
We searched PubMed for studies published until March 1, 2016, with the terms "HIV" AND ("self-test*" OR "home test"). Several studies have noted high acceptability, accuracy, and safety of HIV self-testing in sub-Saharan Africa among individuals who directly receive a self-test. Community-based studies in Malawi have shown high uptake of self-testing, as well as linkage to HIV care that is comparable to what is found in other testing strategies. However, little is known about optimal distribution strategies to facilitate self-test use by high-risk, hard-to-reach individuals and to identify HIV-positive individuals. As opposed to primary distribution strategies that directly reach these individuals, secondary distribution is a strategy in which easier-to-reach individuals are given multiple self-tests to distribute to harder-to-reach individuals such as sexual partners or others in their social network. One pilot study involving a sample of high-risk men who have sex with men in the USA explored the feasibility of secondary distribution of HIV self-tests. 27 participants documented high acceptability and showed potential for use of self-tests to screen sexual partners. No studies in sub-Saharan Africa have explored secondary distribution of self-tests by pregnant and post-partum women or other key populations such as female sex workers.

Added value of this study
To our knowledge, this is the first assessment of the potential for secondary distribution of HIV self-tests by multiple populations of women to promote HIV testing among male

sexual partners and among couples. This is also the first study to show that secondary distribution of self-tests by female sex workers can result in HIV testing among their high-risk commercial sex clients and that this strategy can identify a high proportion of HIV-positive individuals. Another important contribution of this study is its identification of a major potential for a secondary distribution strategy to facilitate point-of-sex HIV testing and lead to safer, better informed sexual decision making. The study shows that secondary distribution of self-tests is a safe and efficient way to promote HIV testing among hard-to-reach individuals and also achieve other HIV prevention objectives.

Implications of all the available evidence
These findings suggest that secondary distribution of HIV self-tests is a promising strategy for increasing HIV testing among populations that are traditionally hard to reach, including male partners of pregnant and postpartum women and clients of female sex workers. It may also facilitate safer sexual decisions by removing some barriers to mutual disclosure of HIV status. Further implementation and evaluation of this strategy is warranted as countries are developing HIV self-testing policies and considering how these technologies can be used to prevent new HIV infections. Along with other community-based HIV testing strategies implemented recently, secondary distribution of self-tests can be part of a multipronged approach to achieving the first of the UNAIDS 90-90-90 targets.

interest in and acceptability of HIV self-testing among a wide range of populations, including those with lower likelihood of testing in other HIV testing and counselling strategies or higher risks of being HIV-positive.[6,8,9] Some countries, such as Kenya, have already included regulated HIV self-testing in their national HIV testing and counselling guidelines and several are considering scaling up the availability of self-tests.[10,11]

Although HIV self-testing can be a good alternative for those not engaged in regular repeat testing, little is known about the best distribution strategies to facilitate self-test use by hard-to-reach and high-risk individuals. One such strategy is secondary distribution of HIV self-tests, whereby an individual who is given multiple self-tests can distribute them to sexual partners or to others in their social network. In addition to promoting HIV testing, secondary distribution of self-tests also has potential to facilitate point-of-sex testing, which can lead to results disclosure and safer, better informed sexual decisions. To date, no data exist for the feasibility of secondary distribution of self-tests in sub-Saharan Africa; however, a few qualitative studies done among men who have sex with men (MSM) in the USA have shown that this strategy might help to increase individuals' knowledge of their partner's status and promote safer sexual decisions.[12]

We aimed to assess whether secondary distribution of self-tests can promote HIV testing among partners of pregnant women, post-partum women, and female sex workers in a high HIV prevalence setting in Kenya. We also assessed whether secondary distribution of self-tests led to couples testing and more informed, safer sexual decisions by women.

Methods
Study design and participants
This cohort study was done at several sites in the Kenyan city of Kisumu, where adult HIV prevalence is 20·6% among women and 17·8% among men.[13] The study explored secondary distribution of self-tests by several different populations of HIV-negative women. Women seeking antenatal care or post-partum care were recruited because there is a high risk of HIV transmission in these populations and male partner testing can help to reduce this risk.[14–16] In addition, female sex workers were recruited because promoting HIV testing among their sexual partners (including commercial sex clients) can help to identify HIV-positive men and reduce HIV infection risk by the female sex workers.[17,18]

Women receiving antenatal care and post-partum care were recruited from a government health facility where

nurses gave each woman a referral coupon to bring to study staff if she was interested in participating. Clinic records and self-reported information were used to determine eligibility of women meeting the following criteria: 18–39 years of age, HIV-negative at most recent HIV test (based on clinic records), gestational age 5 months or less (antenatal care) or child age older than 6 weeks but younger than 6 months (post-partum clinic), and having at least one sexual partner. Women who stated they believed violence would result from distributing a self-test to their sexual partners were excluded.

Female sex workers were recruited from a drop-in centre that provides HIV prevention, care, and treatment services to key populations including female sex workers, MSM, and people who inject drugs. By use of the centre's records of HIV-negative female sex workers (those having tested at the drop-in centre in the past 3 months), a random sample was selected to participate in the study. Peer educators at the centre who had completed human participants protection training contacted and referred the sampled female sex workers to study staff. The female sex workers who were randomly sampled had the option of declining to participate in the study. Those who met with study staff were eligible if aged 18–39 years and HIV-negative.

The study received approval from the Office of Human Research Ethics at the University of North Carolina at Chapel Hill and the Ethical Review Committee at the Kenya Medical Research Institute. Eligible women who wished to participate provided written informed consent in their preferred language as well as their phone number and locator information.

Procedures

Trained study staff instructed the women who met eligibility criteria and gave informed consent on how to use oral fluid based rapid HIV tests (OraQuick Rapid HIV-1/2 antibody tests, OraSure Technologies, Bethlehem, PA, USA) and gave them multiple test kits. Participants receiving antenatal care or post-partum care were given three test kits each and female sex workers were given five. Study staff showed participants how to use the tests to facilitate correct use and to increase capability to explain to other individuals. Specifically, study staff explained the opening of the test kits, collection of oral fluid samples, and the reading of results after a wait of 20 min. They also informed participants about the window period during which antibodies to HIV cannot be detected and gave them one-page instruction sheets to accompany each test kit. In addition, study staff counselled participants about the need to use discretion when introducing self-tests to sexual partners by assessing probable reactions of their partners as well as the risk of intimate partner violence. A 24 h telephone hotline was established for participants or other self-test users to call for further advice on use of the tests, reporting intimate partner violence, or receiving referral

for HIV confirmatory testing, treatment, or intimate partner violence services. At enrolment, participants also responded to a baseline questionnaire about demographic characteristics, previous HIV testing behaviour, and sexual behaviour.

Follow-up questionnaires were administered to participants within 3 months of enrolment; these were typically administered at the health facility or drop-in centre, but in some cases participants were visited at their homes if more convenient. These questionnaires obtained information on how participants used the self-tests as well as reactions to and behaviours after secondary distribution of self-tests. All questionnaires were administered by study staff in face-to-face interviews and in a private space. Data were recorded

	Antenatal care	Post-partum care	Female sex workers
Number of participants enrolled*	60	116	101
Age (years)			
18–24	31 (52%)	61 (53%)	22 (22%)
25–29	24 (40%)	42 (36%)	46 (46%)
>30	5 (8%)	13 (11%)	33 (33%)
Ethnic group			
Luo	40 (67%)	84 (72%)	79 (78%)
Luhya	10 (17%)	18 (16%)	12 (12%)
Other	10 (17%)	14 (12%)	10 (10%)
Highest level of education			
Some primary or completed primary	11 (19%)	38 (33%)	59 (59%)
Some secondary	27 (46%)	45 (39%)	34 (34%)
Secondary or higher	21 (36%)	32 (28%)	7 (7%)
Marital status			
Married	51 (85%)	109 (94%)	10 (10%)
Not married but living together	2 (3%)	0	9 (9%)
Separated or widowed	1 (2%)	0	31 (31%)
Never married	6 (10%)	7 (6%)	51 (50%)
Has a primary sexual partner	60 (100%)	116 (100%)	85 (84%)
Used a condom during last sexual encounter	3 (5%)	23 (20%)	73 (72%)
Had an HIV test in past 12 months	59 (98%)	113 (97%)	101 (100%)
Primary partner had an HIV test in past 12 months†			
No	3 (5%)	17 (15%)	9 (11%)
Yes	49 (82%)	74 (64%)	58 (70%)
Don't know	8 (13%)	25 (22%)	16 (19%)
Experienced intimate partner violence in past 12 months	16 (27%)	53 (46%)	44 (44%)
Heard of HIV self-testing before study	5 (8%)	21 (18%)	18 (18%)

Data are n (%), unless otherwise specified. *Excludes participants who withdrew from study after enrolment. †Among participants who report having a primary sexual partner.

Table 1: Baseline characteristics

with an open-source software package (Open Data Kit, Seattle, WA, USA) installed on Android tablet devices. Participants were counted as lost to follow-up if study staff were unable to contact them at 3 months after at least three attempts.

Outcomes

Key outcomes assessed included the number of self-tests distributed by participants to other individuals, the proportion of participants in each group who distributed a self-test to their primary sexual partner, and among participants who were female sex workers, the proportion who distributed more than one self-test to their commercial sex clients. The proportion of participants who reported offering self-tests to more than one individual who declined to accept the tests was also calculated.

For each self-test distributed to and used by a male sexual partner, couples testing was defined as having occurred if the participant reported testing together with a partner. Additionally, we summarised the proportion of all self-tests distributed that were reported to have an HIV-negative, HIV-positive, or unknown result. In cases where an HIV-positive test result was reported, participants were asked if the individual sought confirmatory testing at a clinic and whether they had sought HIV care at the time of the follow-up interview.

Sexual decision making after self-test distribution to a sexual partner was examined by assessing whether the participant reported having sexual intercourse with the partner since distribution of the self-test, and whether a condom was used when sexual intercourse did occur. Intimate partner violence was assessed with questions adapted from the Kenya Demographic and Health Survey[19] that inquired whether participants had experienced physical, emotional, or sexual violence from their primary sexual partner (for antenatal care and post-partum care participants) and from any sexual partner (for female sex worker participants). Intimate partner violence assessments in follow-up interviews were categorised by whether or not violence resulted from self-test distribution.

Statistical analysis

For all outcomes, we did descriptive analyses of the outcomes for participants in the three participant groups who were not lost to follow-up. For analyses of couples testing and of reported HIV test result for those receiving self-tests from participants, we focused on self-tests distributed to sexual partners. To understand how sexual behaviour was influenced by distribution of self-tests to sexual partners, we used Fisher's exact tests comparing participants' reports of sexual intercourse and condom use (conditional upon intercourse) with sexual partners by HIV self-test result. All data were analysed with Stata 14.1 (StataCorp, College Station, TX, USA).

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

Between Jan 14, 2015, and March 13, 2015, 280 participants were enrolled (61 in antenatal care, 117 post-partum clinic, and 102 female sex workers). At the facility where participants receiving antenatal care and post-partum care were recruited, clinic staff referred 78 women seeking antenatal care and of these, 12 (15%) declined to participate in the study and five (6%) were deemed ineligible on further screening. Clinic staff referred 148 women seeking post-partum care, among whom 14 (9%) declined to participate and 17 (11%) were ineligible. 143 female sex workers were randomly selected for tracing by peer

	Antenatal care	Post-partum care	Female sex workers
Number of participants completing a follow-up interview	58	106	101
Number of self-tests used by participants			
0	22 (38%)	25 (24%)	29 (29%)
1	36 (62%)	78 (74%)	66 (65%)
2	0	3 (3%)	6 (6%)
Number of self-tests distributed by participants to other individuals			
0	1 (2%)	0	0
1	4 (7%)	12 (11%)	1 (1%)
2	41 (71%)	87 (82%)	8 (8%)
3	12 (21%)	7 (7%)	24 (24%)
4	..	..	57 (56%)
5	..	..	11 (11%)
Participants who distributed ≥1 self-tests			
To a primary sexual partner*	53 (91%)	91 (86%)	64 (75%)
To a non-primary sexual partner‡	..	..	17 (17%)
To a commercial sex client	..	..	82 (81%)
To a female friend	42 (72%)	84 (79%)	32 (32%)
To a male friend	19 (33%)	18 (17%)	19 (19%)
Offered ≥1 self-test but received a refusal	14 (24%)	20 (19%)	20 (20%)
Number of individuals who refused a self-test, mean (SD)	0·50 (0·98)	0·27 (0·54)	0·25 (0·54)
Would recommend self-testing to a friend	57 (98%)	104 (98%)	101 (100%)
Belief about accuracy of self-tests			
Very accurate	48 (83%)	78 (74%)	97 (96%)
Somewhat accurate	6 (10%)	22 (21%)	4 (4%)
Neutral	1 (2%)	4 (4%)	0
Don't know	3 (5%)	2 (2%)	0
Reported intimate partner violence resulting from self-test distribution	0	2 (2%)	2 (2%)

Data are n (%), unless otherwise specified. *Percentages based on number of participants who reported having a primary sexual partner at baseline. †Defined as sexual partners who were neither primary nor commercial sex clients.

Table 2: Test use and distribution by participants

educators. Of these, 21 (15%) could not be located, 12 (8%) declined study participation, and nine (6%) were referred to study staff but did not meet study inclusion criteria. Among the 280 enrolled participants, 265 (95%) completed a follow-up interview by May 30, 2015, three (1%) withdrew from the study and were excluded from the analyses, and 12 (4%) were lost to follow-up.

Over half the participants recruited through antenatal and post-partum care were aged 18–24 years, whereas nearly half the female sex workers were aged 25–29 years (table 1). Most participants had completed primary or some secondary education. However, compared with participants receiving antenatal care or post-partum care, a smaller proportion of female sex workers had completed secondary education. Nearly all of the participants recruited through antenatal or post-partum care were married. By contrast, only ten (10%) of 101 female sex workers were married, although 85 (84%) reported having a primary sexual partner. Almost all participants had been tested for HIV in the past 12 months. Participants in all three participant groups reported high rates of intimate partner violence in the past year, ranging from 27–46%.

Most participants in all participant groups reported use of at least one self-test themselves (table 2). They also distributed self-tests to other individuals; 265 participants with follow-up data reported distributing 709 self-tests. Participants receiving antenatal and post partum care distributed a mean of 2·14 and 1·95 self-tests to other

individuals, respectively, whereas female sex workers distributed a mean of 3·69 self-tests (figure 1). All but one participant reported distributing one or more self-tests to other individuals and about 90% of participants receiving antenatal care or post-partum care distributed two or three self-tests, whereas all female sex workers distributed three or more self-tests (table 2).

Nearly all participants with a primary sexual partner at baseline reported distributing a self-test to that partner: 53 (91%) of 58 in antenatal care, 91 (86%) of 106 in post-partum care; and 64 (75%) of 85 female sex workers.
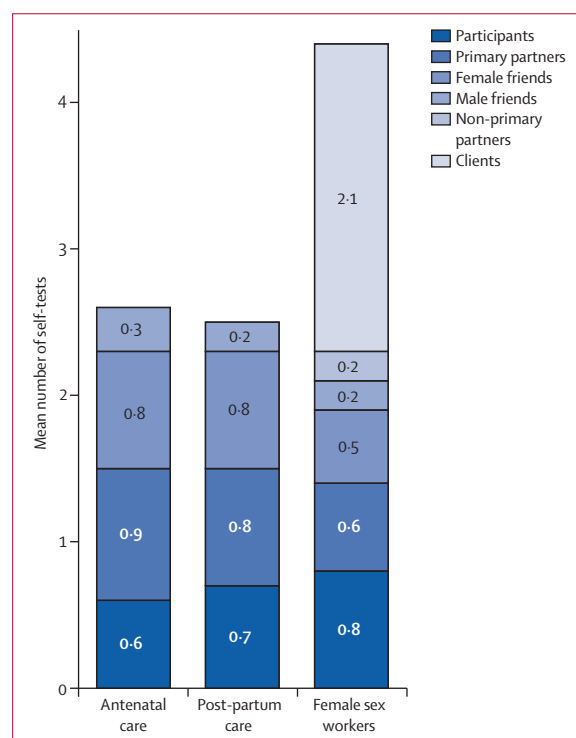

Figure 1: **Number of self-tests used by participants or distributed to other individuals**

	Antenatal care	Post-partum care	Female sex workers
Self-tests distributed by participant to male sexual partners, n	53	91	301
Self-tests distributed to and used by male sexual partners, n	53	91	298
Relationship to participant of sexual partner who used self-test			
Primary sexual partner*	53 (100%)	91 (100%)	64 (21%)
Non-primary sexual partner	..	..	23 (8%)
Commercial sex client	..	..	211 (71%)
Participant reported being present when sexual partner used self-test	53 (100%)	88 (97%)	248 (83%)
Participant reported couples testing with primary sexual partner†	27 (51%)	62 (68%)	53 (83%)
Participant reported couples testing with non-primary sexual partner or commercial sex client‡	..	..	39 (17%)
Time between enrolment and use of self-test			
Within 1 week	46 (87%)	76 (84%)	193 (65%)
1–2 weeks	4 (8%)	10 (11%)	62 (21%)
>2 weeks	3 (6%)	5 (5%)	23 (8%)
Don't know	0	0	20 (7%)
Location where self-test was used			
Own home	50 (94%)	88 (97%)	39 (13%)
Recipient home	3 (6%)	2 (2%)	101 (34%)
Guesthouse/bar/club	0	0	150 (50%)
Don't know	0	1 (1%)	8 (3%)
Perception of self-test for individual who received self-test from participant			
Very positive	40 (75%)	58 (64%)	264 (89%)
Somewhat positive	9 (17%)	25 (27%)	16 (5%)
Neutral	0	0	2 (1%)
Somewhat negative	4 (8%)	7 (8%)	5 (2%)
Very negative	0	0	1 (<1%)
Don't know	0	1 (1%)	10 (3%)
Ease of use of self-test for individual who received self-test from participant			
Very easy	32 (60%)	54 (59%)	171 (57%)
Somewhat easy	13 (25%)	21 (23%)	43 (14%)
Neutral	2 (4%)	9 (10%)	8 (3%)
Somewhat difficult	6 (11%)	7 (8%)	51 (17%)
Very difficult	0	0	25 (8%)

Data are n (%) unless otherwise specified. *Two primary partners in the antenatal group and three in postpartum care group each used two self-tests, these duplicate tests were not included in this table. †Among self-tests distributed to and used by a primary sexual partner. ‡Among self-tests distributed to and used by a non-primary sexual partner or commercial sex client.

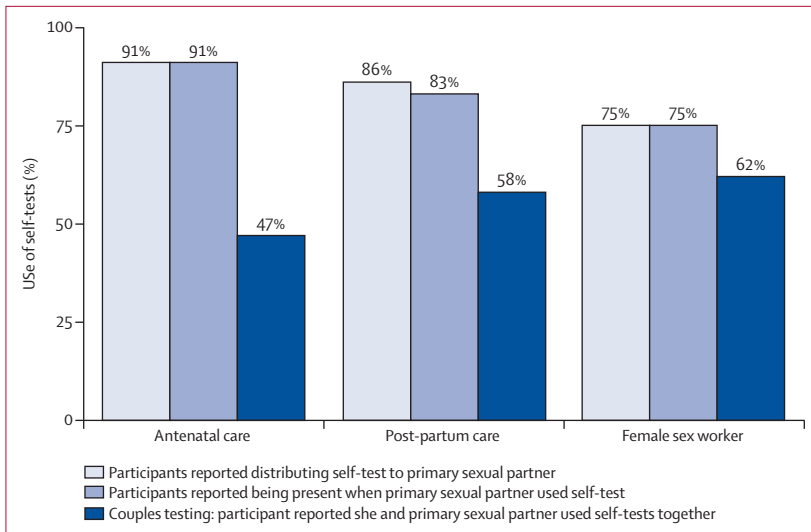*Table 3:* **Characteristics of sexual partners who received self-tests from participants**

Figure 2: Distribution to and use of self-tests with primary sexual partners

Among participants who have a primary sexual partner and completed a follow-up interview (58 in antenatal care, 106 in post-partum care, and 85 female sex workers).

	Antenatal care	Post-partum care	Female sex workers
Sexual partners tested using self-tests, n	53	91	298
HIV self-test results of sexual partners			
HIV-negative	51 (96%)	87 (96%)	242 (81%)
HIV-positive	2 (4%)	2 (2%)	41 (14%)
Don't know	0	2 (2%)	15 (5%)
Relationship to participant of sexual partner who used self-test (HIV-positive only)			
Primary partner	2 (100%)	2 (100%)	2 (5%)
Non-primary sexual partner	..	-	2 (5%)
Commercial sex client	..	-	37 (90%)
Went for confirmatory testing after receiving HIV-positive HIV self-test result?*			
Yes	0	2 (100%)	26 (65%)
No	2 (100%)	0	3 (8%)
Don't know	0	0	11 (28%)
Enrolled in HIV care after receiving HIV-positive HIV self-test result?*			
Yes	0	2 (100%)	23 (58%)
No	2 (100%)	0	3 (8%)
Don't know	0	0	14 (35%)

Data are n (%), unless otherwise specified. *Confirmatory testing and linkage to care by sexual partners are based on participants' reports. One HIV-positive sexual partner of a female sex worker was excluded because he was reported to already know his HIV status.

Table 4: Self-test results, confirmatory testing, and linkage to care of sexual partners

Participants did not always succeed in distributing self-tests to individuals in their social and sexual networks. In the three participant groups, about 20% of participants reported offering a self-test to at least one individual who declined to accept it (table 2). Additionally, of the 265 participants with follow-up data, very few (four) reported intimate partner violence during the 3 month follow-up period as a result of use or distribution of self-tests. Three reported physical violence after self-testing with their partner, whereas one reported leaving her home temporarily because of verbal abuse from her partner. No other adverse events were reported.

Of the 445 self-tests that participants distributed to male sexual partners, 442 (99%) were reported to be used by those partners (table 3). Participants almost always reported being present when the sexual partner used the self-test and couples-testing was common when tests were distributed to primary sexual partners. For the 53 self-tests that participants receiving antenatal care reported distributing to and being used by their primary sexual partner, couples-testing occurred in 27 (51%) of the cases. For participants receiving post-partum care, couples-testing occurred with 62 (68%) of the 91 primary sexual partners who accepted self-tests. For female sex workers, couples-testing occurred with 53 (83%) of 64 primary sexual partners who accepted self-tests, but in just 39 (17%) of 234 tests with other sexual partners (including clients) who accepted self-tests. Overall, when including the few participants who did not distribute a self-test to their primary sexual partner, couples-testing with the primary sexual partner ranged from 47–62% in the three participant groups (figure 2). Among male sexual partners who received self-tests from participants, reported acceptability was high. Most of these partners were reported to consider self-tests somewhat or very easy to use.

The proportion of male sexual partners who accepted self-tests who obtained an HIV-positive result ranged from 2% (post-partum care group) to 14% (female sex worker group; table 4). Few primary sexual partners were reported an HIV-positive result. In the female sex workers group, however, 37 (90%) of the 41 sexual partners who obtained an HIV-positive result were commercial sex clients. Neither of the two HIV-positive sexual partners of participants receiving antenatal care had sought confirmatory testing or linked to HIV care within the 3 month follow-up period. However, both of the HIV-positive individuals identified by participants receiving post-partum care were reported to have sought confirmatory testing and linked to care within the same period. Of the 41 HIV-positive individuals identified by female sex workers participants who did not already know their HIV status, 26 (65%) had sought confirmatory testing within the 3 month follow-up period and 23 (58%) were reported to have linked to care. Female sex workers did not know whether the individual had sought confirmatory testing in 11 cases (28%), and linkage to care was unknown in 14 (35%).

Female sex workers were very likely to distribute self-tests to other sexual partners as well, with more than 80% of them distributing one or more self-tests to commercial sex clients. Participants also distributed self-tests to individuals who were not sexual partners. About 75% of participants receiving antenatal care or post-partum care distributed one or more self-tests to a female friend, whereas 32 (32%) of the 101 female sex workers distributed one or more self-tests to a female friend.

Sexual intercourse was significantly less likely when participants' sexual partners tested HIV-positive (18%) than when they tested negative (62%; p<0·0001; table 5). Similarly, condom use among those who reported sexual intercourse was significantly higher after a sexual partner tested HIV-positive (100%) versus HIV-negative (44%; p=0·0018). Such sexual decision making on the basis of the result of the partner's self-test result was evident in participants receiving antenatal care or post-partum care and female sex workers.

Discussion

Provision of multiple self-tests to women for secondary distribution seems to be a safe, viable, and promising strategy to promote HIV testing among male sexual partners and to facilitate safer sexual decisions. A high proportion of pregnant and post-partum women as well as female sex workers were able to distribute self-tests to other individuals, particularly their sexual partners. This strategy also resulted in high levels of couples testing. Among female sex workers in particular, secondary distribution resulted in HIV testing among high risk male clients, with a high proportion of individuals obtaining an HIV-positive result. Another important finding was that secondary distribution of self-tests led to significant changes in sexual behaviour on the basis of test results, a further indication of the major HIV prevention potential of this strategy.

Although several studies have documented the acceptability, accuracy, and safety of self-testing among individuals who are provided with self-tests directly (primary distribution),[6,9,20,21] to our knowledge this is the first study to assess the feasibility of secondary distribution of self-tests in sub-Saharan Africa. One pilot study in the USA has explored this strategy among MSM,[12,22] and a recent community-based study in Malawi included an option for couples to receive multiple self-tests in their homes but did not directly assess secondary distribution as a strategy.[21,23] In this study, secondary distribution of self-tests by women who received multiple kits was extremely high, with most women distributing all of the tests provided to them.

About 90% of pregnant and post-partum women reported that their primary sexual partner used a self-test, and most reported testing together. Promoting HIV testing among men in these settings would not only carry prevention benefits for their female sexual partners, but could also be beneficial for their own health through earlier initiation of ART for those who are HIV positive.[24] The high levels of male partner testing and couples testing achieved in this study are noteworthy because accessing male partners at clinics has proven challenging and provider-initiated strategies such as the provision of written invitations for partners or doing home visits have either had little success or are likely to require substantial financial and human resources for implementation.[25–27] These results suggest that provision of multiple self-tests

	Antenatal care	Post-partum care	Female sex workers	Total
Participant had sexual intercourse with sexual partner after he used a self-test				
HIV-negative self-test result	38/51 (75%)	66/87 (76%)	131/242 (54%)	235/380 (62%)
HIV-positive self-test result	0	1/2 (50%)	7/41 (17%)	8/45 (18%)
p value†	..	..	..	<0·0001
Condom used during last sexual intercourse with sexual partner*				
HIV-negative self-test result	1/38 (3%)	12/66 (18%)	91/131 (69%)	104/235 (44%)
HIV-positive self-test result	..	1/1 (100%)	7/7 (100%)	8/8 (100%)
p value†	..	..	..	0·0018

Data are n (%), unless otherwise specified. *Among participants who reported sexual intercourse with sexual partner after he used a self-test. †p value from Fisher's exact test comparing means for participants whose sexual partners obtained an HIV-negative and HIV-positive self-test result.

Table 5: Sexual decision making of participants

to women attending antenatal and post-partum clinics should receive further consideration.

Among female sex workers who participated in the study, a key finding is that about one in six self-tests distributed to commercial sex clients were reported to have an HIV-positive result. This proportion was comparable to HIV prevalence among adult males in the study region (18%),[13] although that an even higher proportion of clients did not test HIV-positive given their higher risk profiles is surprising. Underreporting of HIV-positive results could be one explanation, as could the age distribution among clients and the possibility that female sex workers avoided self-test distribution and used condoms with their highest-risk clients. Overall, this finding suggests that providing female sex workers with multiple self-tests can be a highly efficient way to identify HIV-positive individuals. More generally, an appealing aspect of the strategy is that it promotes testing through existing sexual and social networks of female sex workers.

Another important finding is the potential for the secondary distribution intervention to facilitate more informed sexual decisions when used as a point-of-sex decision-making instrument. Female sex workers in particular reported being less likely to have sexual intercourse with men who obtained an HIV-positive self-test result than with those who obtained an HIV-negative result, and when they did have sexual intercourse with men with positive results they were more likely to use condoms. Because of the structural barriers to condom use among female sex workers and economic incentives that favour sex without condoms,[18,28] this result is important from an HIV prevention standpoint and suggests that access to multiple self-tests could empower female sex workers to protect themselves from HIV. These results are also consistent with pilot studies done among MSM in the USA, in which MSM reported using self-tests to screen partners and make informed sexual decisions.[12,29] Such use of self-tests might nonetheless pose risks because of the window period of many existing tests. However, it could also result in a net benefit if

unsafe sexual behaviour is more likely when tests are unavailable. Additional qualitative research and mathematical modelling is needed to explore implications of wider use of self-tests for sexual decision making.

Reported intimate partner violence resulting from self-test distribution was extremely rare in this study. This finding is promising in view of the high proportion of participants who reported previous intimate partner violence at baseline. The low frequency in our study could be because women used discretion when choosing individuals to whom they should offer self-tests. Participants also reported that acceptability of self-tests by individuals who received them was very high. Compared with rates of intimate partner violence reported in studies of couples testing by counsellors and in studies that sought to promote male partner testing, the rates in our study were lower.[25] Nonetheless, further monitoring in future secondary distribution interventions is needed, as are systems to support women who experience intimate partner violence.

In Kenya and other countries, individuals receiving a positive self-test result are recommended to seek confirmatory testing for diagnosis of HIV.[11] Although promotion of linkage to care was not an objective of the study, all self-test kits included information about the importance of confirmatory testing and included a phone hotline that users could call. We estimate that more than 50% of those who obtained an HIV-positive result sought confirmatory testing and linked to care. Linkage to care was only measured during the 3 month study follow-up period. Because individuals who received a self-test from participants soon after study enrolment had more time to link to care than those who received a self-test several weeks after enrolment, we might have underestimated linkage. Nonetheless, our estimates are comparable to those from a large-scale self-testing study in Malawi that actively promoted linkage to care[21] and with those from many facility-based and community-based HIV testing and counselling strategies in sub-Saharan Africa;[3,30] although they are lower than those from community-based interventions that facilitated linkage to care.[3]

An inherent limitation of many studies of unsupervised self-testing is the difficulty of verifying use and accuracy of the tests. In this study, all information was obtained through participants' reports, and thus we were unable to verify self-test distribution, use, or results. However, all participants were told there was no obligation to distribute self-tests and reporting bias is likely to have been minimal. The fact that many participants reported not distributing all the self-tests given to them, supports the notion of limited reporting bias. Moreover, bias in reporting HIV test results for the individuals who accepted self-tests from participants would most likely be an underestimate of the proportion of HIV-positive people identified. Generalisability of our results might be limited by the selection of participants, which included women who were actively engaged in health services and were interested in distributing tests in their sexual and social networks. From an implementation perspective, however, providing multiple self-tests to women who are easily accessed can be a feasible and efficient way to implement the intervention and to reach male partners. The study also did not assess the feasibility of secondary distribution by HIV-positive women or by men, or the implications of providing more than three or five self-tests. These should be among the priorities for future research.

Other limitations include not inquiring about previous knowledge of HIV status among men who accepted self-tests from participants. Future research would benefit not only from acquiring more information on testing history of sexual partners who accept a self-test, but also from engaging with men directly to solicit additional information on perceptions around secondary distribution by women. Moreover, although our results suggest that secondary distribution of self-tests is a promising strategy to promote male partner testing and also identify HIV-positive individuals, further research is necessary to assess the effectiveness and cost-effectiveness of this strategy.

In summary, secondary distribution of self-tests by women is a novel strategy that has the potential to accomplish multiple HIV prevention objectives, including male partner HIV testing, couples testing, and safer sexual decision making. It could be a particularly effective strategy among key populations such as female sex workers, because it identified many HIV-positive partners and led to reduced sexual risk behaviours. Further implementation and evaluation of this strategy is warranted as countries develop HIV self-testing policies and consider how these technologies can be used to prevent new HIV infections.

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