Published in final edited form as:

AIDS. 2012 January 14; 26(2): 217–227. doi:10.1097/QAD.0b013e32834dc593.

INFLUENCE NETWORK AGENT EFFECTIVENESS IN PROMOTING COUPLES' HIV COUNSELING AND TESTING IN KIGALI, RWANDA

Kristin Wall, MS,

Department of Epidemiology, Emory University, Atlanta, GA, USA

Etienne Karita, MD, MSc, MSPH,

Project San Francisco (PSF), Kigali, Rwanda; Rwanda Zambia HIV Research Group (RZHRG),
Department of Pathology and Laboratory Medicine, School of Medicine, Emory University,
Atlanta, GA, USA

Azhar Nizam, MS,

Department of Biostatistics and Bioinformatics, Hubert Department of Global Health, Rollins
School of Public Health, Emory University, Atlanta, GA, USA

Brigitte Bekan, MD, MPH, PSF, RZHRG,

Dept of Pathology & Laboratory Medicine, School of Medicine, Emory University, Atlanta, GA,
USA

Gurkiran Sardar, MPH, PSF, RZHRG,

Corresponding Author: Kristin M. Wall, Department of Epidemiology, School of Public Health, Emory University, 1518 Clifton
Road NE, 3rd Floor, Atlanta, GA 30322, Phone: (512) 785-4779, kmwall@emory.edu.

Justification for 12 authors: All authors have read and approved the submitted text. Twelve individuals co-authored this manuscript
and meet the International Committee of Medical Journal Editors criteria for authorship. Co-authors were integral to the conception,
development, implementation, and presentation of this study. Each author's contributions are detailed below.

Authors' contributions

Kristin Wall – contributed to the analysis and interpretation of data; drafted the article and revised it critically for important
intellectual content; and gave final approval of the version to be published

Etienne Karita – contributed to the conception and design of the study; revised the article critically for important intellectual content;
and gave final approval of the version to be published

Azhar Nizam – contributed to the analysis and interpretation of data; revised the article critically for important intellectual content;
and gave final approval of the version to be published

Brigitte Bekan – contributed to the conception of the study and acquisition of data; revised the article critically for important
intellectual content; and gave final approval of the version to be published

Gurkiran Sardar – contributed to the conception of the study and acquisition of data; revised the article critically for important
intellectual content; and gave final approval of the version to be published

Debbie Casanova – contributed to the conception of the study and acquisition of data; revised the article critically for important
intellectual content; and gave final approval of the version to be published

Dvora Joseph – contributed to the conception of the study and acquisition of data; revised the article critically for important
intellectual content; and gave final approval of the version to be published

Freya DeClercq – contributed to the conception of the study and acquisition of data; revised the article critically for important
intellectual content; and gave final approval of the version to be published

Evelyn Kestelyn – contributed to the conception of the study and acquisition of data; revised the article critically for important
intellectual content; and gave final approval of the version to be published

Roger Bayingana – contributed to the conception of the study and acquisition of data; revised the article critically for important
intellectual content; and gave final approval of the version to be published

Amanda Tichacek – contributed to the study conception and design; revised the article critically for important intellectual content; and
gave final approval of the version to be published

Susan Allen – contributed to the study design and conception; contributed to the analysis and interpretation of data; revised the article
critically for important intellectual content; and gave final approval of the version to be published

Conflicts of interest

The authors have no conflicts of interest, including relevant financial interests, activities, relationships, and affiliations.

Dept of Pathology & Laboratory Medicine, School of Medicine, Emory University, Atlanta, GA, USA

Debbie Casanova, MPH, PSF, RZHRG,

Dept of Pathology & Laboratory Medicine, School of Medicine, Emory University, Atlanta, GA, USA

Dvora Joseph, MPH, PSF, RZHRG,

Dept of Pathology & Laboratory Medicine, School of Medicine, Emory University, Atlanta, GA, USA

Freya De Clercq, BA, PSF, RZHRG,

Dept of Pathology & Laboratory Medicine, School of Medicine, Emory University, Atlanta, GA, USA

Evelyne Kestelyn, MSc, PSF, RZHRG,

Dept of Pathology & Laboratory Medicine, School of Medicine, Emory University, Atlanta, GA, USA

Roger Bayingana, MD, MSc(cand) PSF, RZHRG,

Dept of Pathology & Laboratory Medicine, School of Medicine, Emory University, Atlanta, GA, USA

Amanda Tichacek, MPH, RZHRG, and

Dept of Pathology & Laboratory Medicine, School of Medicine, Emory University, Atlanta, GA, USA

Susan Allen, MD, MPH

Rwanda Zambia HIV Research Group, Dept of Pathology & Laboratory Medicine, School of Medicine and Hubert Dept of Global Health, Rollins School of Public Health, Emory University, Atlanta, GA, USA

Abstract

Objective—To identify predictors of promotion of couples' voluntary counseling and testing (CVCT) in Kigali, Rwanda

Design—Analysis of CVCT promotional agent (influential network leaders, INLs; influential network agents, INAs), and couple/invitation-level predictors of CVCT uptake.

Methods—Number of invitations and couples tested were evaluated by INL, INA, and couple/contextual factors. Multivariable logistic regression accounting for two-level clustering analyzed factors predictive of couples' testing.

Results—26 INLs recruited and mentored 118 INAs who delivered 24,991 invitations. 4,513 couples sought CVCT services after invitation. INAs distributed an average of 212 invitations resulting in an average of 38 couples tested/agent. Characteristics predictive of CVCT in multivariate analyses included the invitee and INA being socially acquainted (aOR=1.4;95%CI: 1.2–1.6); invitations delivered after public endorsement (aOR=1.3;95%CI:1.1–1.5); and presence of a mobile testing unit (aOR=1.4;95%CI:1.0–2.0). In stratified analyses, predictors significant among cohabiting couples included invitation delivery to the couple (aOR=1.2;95%CI:1.0–1.4) in the home (aOR=1.3;95%CI:1.1–1.4), while among non-cohabiting couples predictors included invitations given by unemployed INAs (aOR=1.7;95%CI:1.1–2.7). Cohabiting couples with older men were more likely to test, while younger age was associated with testing among men in non-cohabiting unions.

Conclusions—Invitations distributed by influential people were successful in prompting couples to seek joint HIV testing, particularly if the invitation was given in the home to someone

known to the INA, and accompanied by a public endorsement of CVCT. Mobile units also increased the number of couples tested. Country-specific strategies to promote CVCT programs are needed to reduce HIV transmission among those at highest risk for HIV in sub-Saharan Africa.

Keywords

Community Workers; Couples' Voluntary Counseling and Testing; HIV; Rwanda

Introduction

In Kigali, Rwanda's capital, the prevalence of HIV is 7.3% among those aged 15–49, the highest in the country [1]. Prevention interventions have actively taken place in Rwanda since the late-1980s. Still, in 2002, Rwanda was one of the 10 African countries most affected by HIV/AIDS [2]. At that time, prevention efforts based on serostatus awareness were not emphasized [1, 3].

Without knowledge of HIV serostatus, the ability to counsel those with and at-risk for HIV is limited [4]. Routine testing and counseling for pregnant women began in 2001, and expanded to include individuals with symptoms of HIV with the advent of the Global Fund in 2003 and PEPFAR in 2005 [5–7]. To date, approximately 21% of adults in sub-Saharan Africa know their HIV status [8]. One particularly efficacious prevention program is couples' HIV voluntary counseling and testing (CVCT) in which long-term sexual partners are tested together, mutually disclose results, and receive counseling to develop risk-reduction plans based on their serostatus [3]. Couples are a critical prevention point [9, 10]; approximately 30% to 70–90% of heterosexual HIV transmissions in sub-Saharan Africa occur within stable relationships [11, 12]. In Kigali, 6.2% of couples are in stable relationships in which partners do not share the same HIV status (discordant couples), one of the most vulnerable populations [1, 3].

In 1988, Project San Francisco (PSF) evolved into a couples' counseling and research center in Kigali after women attending antenatal clinics expressed an interest in having their husbands tested for HIV [13]. PSF began CVCT promotions by providing pregnant women with invitations for their partners [9]. Initially, demand for CVCT was low due to beliefs that monogamy is safe, fear, stigma, gender inequality, and lack of knowledge about CVCT services. A male-focused intervention was designed to overcome common misconceptions and was successful in increasing the number of husbands tested [14].

Community health workers have been successful in bridging the gap between individuals and healthcare systems [15]. A prospective cohort study was conducted to test CVCT promotional models in two neighborhoods in Kigali. The Integrated Model of Community-Based Evaluation was used to guide development and implementation of the outreach program [17]. Herein, we identify factors predicting uptake of CVCT in Kigali, Rwanda.

Methods

Setting

Three non-overlapping Kigali neighborhoods were chosen as described elsewhere [18]. Briefly, among nine neighborhoods considered as potential sites, three were selected based on comparable population size and infrastructure. We also sought to maximize distance between the neighborhoods to limit potential spillover effects. Two neighborhoods were then randomly selected to each receive active CVCT promotion combined with a stand-alone CVCT center; a mobile unit crossed over from one neighborhood to the other at the mid-point of the study. Each CVCT center and mobile unit could accommodate 30 couples/

day. Intervention neighborhood catchment populations included 56,809 and 64,049 people, respectively, and duplicate invitation delivery was assumed to be rare. There were several kilometers between the three neighborhoods, none of which included the city center. The sequence of events and overview of the data collection and analysis plan are shown in Fig. 1.

Influence Network Leader and Influence Network Agent recruitment and training

The results of a pilot study using only Influence Network Agents (INAs) [19] indicated that public endorsements of CVCT by community leaders was associated with increased couples' testing. The promotional intervention for this study was thus modified to include 26 Influence Network Leaders (INLs) who then nominated 118 INAs and supported their promotional efforts by making public endorsements of CVCT. Public endorsements conducted by INLs included priests/pastors discussing CVCT during sermons, senior nurses giving talks to clinic patients, factor foremen encouraging employees to test with their spouses, or Parent-Teacher Association leaders presenting CVCT at PTA meetings.

INLs were recruited through referrals from national/citywide umbrella groups in the following networks: 1) Faith-based, 2) Health, 3) Private, and 4) Community-based/non-governmental organization (CBO/NGO) groups. INLs received training from project physicians and senior counselors. INLs recommended INA candidates for interview, selection, and training. INAs who performed successfully in the pilot study [19] were recruited as trainers. Criteria for selection of INLs and INAs considered their scope of influence to avoid spillover effects between neighborhoods.

Training processes included instruction in invitation delivery methods and data collection, with a focus on approaching family, friends, neighbors, and social/work acquaintances as well as promoting door-to-door. INLs and INAs were encouraged to work together. For example, a church pastor INL might endorse CVCT during a sermon, and after the service, deacons (INAs) would distribute invitations to the congregation. Demographic questionnaires were completed by INLs and INAs at enrollment.

Promotional activities

Between July 2004-December 2005, INAs distributed invitations containing CVCT facility directions, description of services, and hours of operation. Invitations were delivered to couples or individuals who indicated they were in steady sexual relationships (Figure 1). INAs submitted data forms bi-weekly and were paid \$0.30/invitation issued plus \$3/couple tested. Couples attending CVCT services received transport reimbursement, lunch, and childcare at CVCT sites.

CVCT

CVCT procedures are detailed elsewhere [20, 21]. Briefly, after giving written informed consent, couples receive pre-test counseling and provide blood for screening and confirmatory rapid HIV tests [22]. Couples receive confidential HIV test results during joint post-test counseling. Mobile testing was scheduled weekly based on availability of resources/facilities such as community centers, schools, churches, or any available building with a large room for group discussions and several small rooms for counseling. This research was conducted with Emory University Institutional Review Board and Rwanda Ethics Committee approvals. All promoters and CVCT participants provided written informed consent.

Data analysis

INAs who delivered no invitations (N=56) or who delivered invitations without at least one invited couple seeking testing (N=11) were excluded from the analysis. The number of invitations, couples tested, and success rates (number of couples tested/number of invitations distributed) were calculated and stratified by INL and INA characteristics and type of couple (cohabiting or non-cohabiting) (Table 1). Cohabiting and non-cohabiting couples were analyzed separately to identify differences in their receptivity to CVCT, and to examine possible differences in INA-level and invitation-level predictors of successful invitations. Bivariate odds ratios and confidence intervals were calculated for INL/INA level predictors of couple-testing (Table 2). Bivariate analysis of the association between couple and invitation characteristics and CVCT uptake were performed using generalized estimating equation (GEE) methods to account for two-level clustering within individual INAs and INLs (Table 3).

A multivariable logistic regression model contained INA-, couple-, and invitation-level characteristics significant in bivariate analyses (Bonferroni p-value 0.002) or characteristics significant in univariate analyses with scientific rationale for inclusion. Effect measure modification by couple cohabitation status was evaluated. GEE analysis methods with exchangeable correlations accounted for two-level clustering of couple and invitation level characteristics within individual INAs and INLs (Table 4). Data analysis was performed with SASv9.2 (Cary, North Carolina).

Results

INL characteristics

The average age of INLs was 38 (inter-quartile range (IQR)=30–45) years, and 73% were men. All INLs were employed, half were homeowners, and they had lived in Kigali for an average of 17 (IQR=9–28) years. Eighty-one percent of INLs were married/dating and half had been tested for HIV with their partner. All INLs understood Kinyarwanda, and most understood French and/or English (Table 1).

INA characteristics and invitation uptake

INAs had an average age of 35 (IQR=28–40) years and had resided in Kigali for an average of 18 (IQR=10–26) years. Most were women (70%) and employed in either the sales/service industry or unskilled manual labor. Nearly half were married/dating, and most owned their home and reported testing for HIV alone. The majority understood Kinyarwanda, but most could not understand French and/or English (Table 1).

INAs distributed 24,991 invitations, and 4,513 couples sought CVCT as a result of an invitation (18% success rate). INAs distributed an average of 212 invitations resulting in an average of 38 couples tested/INA. Most (60%) invitations were issued to cohabiting couples. The success rate with each group (19% cohabiting vs. 17% non-cohabiting) differed by INA characteristics (Table 1).

Network—Faith-based INAs were most successful, distributing the most invitations with the highest success rate (20%). The performance of health network INAs was average in terms of number of invitations and couples tested, but their success rate was substantially higher among cohabiting (21%) vs. non-cohabiting (16%) couples. Private-sector INAs were the least successful (Table 2).

Gender, age, duration of residence in Kigali, and relationship status—On average, men distributed more invitations (220) than women (208), but men and women had

similar success rates in cohabiting and non-cohabiting couples. Increasing INA age was associated with greater success among cohabiting couples, while younger INAs had more success among non-cohabiting couples. Longer residence in Kigali corresponded with a higher likelihood of success among non-cohabiting couples (Table 2). Married/dating INAs had relatively high success rates (Table 1), though this was only significant among non-cohabiting couples (Table 2).

Occupation, language skills, and housing—INAs working in agricultural sectors had the highest success rates among both cohabiting and non-cohabiting couples (Table 1), while unskilled manual laborers had the lowest success rates. INAs in sales/service sectors, professional sectors, and unemployed performed significantly better among non-cohabiting couples than unskilled laborers (Table 2). INAs understanding Kinyarwanda had higher success rates (Table 1), but this was significant only in non-cohabiting couples (Table 2). Interestingly, INAs understanding French and/or English were more successful among non-cohabiting couples but less successful among cohabiting couples. Lastly, INAs owning their homes were less successful, particularly among non-cohabiting couples. The importance of a charismatic outlier was observed: the INA living in housing provided by his employer had a success rate of 56% (Table 1).

Previous HIV testing—Only four INAs had never tested for HIV, and they had low average invitations distributed (181) and low success rate (14%). INAs who tested alone or with their partners were more successful than those who never tested. In stratified analyses, only CVCT remained a significant predictor among non-cohabiting couples (Table 2).

INAs with no successful invitations—Eleven INAs delivered no successful invitations. These INAs distributed an average of 201 invitations and were similar to the 118 INAs in the analysis by gender ($\chi^2=1.1$, $p=0.3$), age (F-statistic=2.3, $p=0.3$), and network ($\chi^2=1.0$, $p=0.8$). Given the high likelihood of fraud (i.e., falsely reporting distribution of invitations), these INAs were excluded from analysis.

Couple and invitation characteristics associated with couples' HIV testing (Table 3)

The mean age of invited men was 31 years and of women was 26 years. Those who tested were slightly older than those who did not. 60% of invited couples were cohabiting and these couples were more likely to seek testing than non-cohabiting couples (19% vs. 17%). When INAs invited couples, testing was more likely than inviting women alone.

Most contacts were initiated by INAs, though in the rare instances when women initiated contact with INAs, the couple was more likely to test. INAs reported that most invitations were not difficult to deliver (operationalized as time-consuming, requiring long explanations, or challenging because of resistance from the invitee or scheduling conflicts).

Most invitations were issued to people known to the INA in the home or workplace. Being a family member or acquaintance was predictive of CVCT relative to having just met. Invitations distributed in the home were more successful than those distributed in the community. Testing was associated with the invitee having heard public CVCT endorsement prior to invitation and the presence of a mobile unit. No differences in success rates were found between the two intervention neighborhoods.

Multivariate model of CVCT uptake predictors (Table 4)

We assessed for multi-collinearity between variables in the multivariate models. Ages of men and women in couples were collinear, and woman's age was excluded. Effect measure modification by couple cohabitation status was observed, and stratified multivariate models

were run. All adjusted odds ratios (aORs) presented in the text below are statistically significant in the multivariate model accounting for two-level clustering.

No INA characteristics were statistically significant among all couples, though INAs in the sales/service industry (aOR=1.6) and unemployed (aOR=1.7) were more successful among non-cohabiting couples. Also among non-cohabiting couples, INAs owning a home were less successful (aOR=0.7) compared with those who rented or had free housing.

Of couple characteristics, older age in men was predictive of increased testing among cohabiting couples (aOR=1.02/year increase) and decreased testing among non-cohabiting couples (aOR=0.97/year increase). Longer duration of relationship was predictive of CVCT uptake among cohabiting couples (aOR=1.03/year increase) but with decreased testing among non-cohabiting couples (aOR=0.58/year increase).

Of invitation characteristics, inviting couples *vs.* individuals was associated with increased testing among cohabiting couples (aOR=1.2). Cohabiting and non-cohabiting couples socially acquainted with the INA were more likely to test (aOR=1.3 and 1.7, respectively). Invitations delivered in the home *vs.* other locations predicted testing among cohabiting couples (aOR=1.3). Invitations accompanied by public endorsements were more successful among cohabiting and non-cohabiting couples (aOR=1.3 and 1.5, respectively), while invitations distributed when a mobile unit was present were more successful among cohabiting couples (aOR=1.5).

Discussion

Promotion of CVCT through influential networks including faith-based, health, private and non-governmental sectors prompted both cohabiting and non-cohabiting couples to seek joint HIV testing. Characteristics of the INA, the invited couple, their relationship, and contextual factors were predictive of successful invitation. INA age, network, occupation, housing, language fluency, marital status, and prior HIV testing were significant predictors of CVCT uptake in crude analysis. Similarly, couple age, cohabitation status, and relationship duration predicted CVCT uptake in crude analyses. Several INA and couple characteristics remained predictive of testing in multivariate analyses. Overall, however, invitation-level contextual characteristics were the most important predictors of couples' testing, including the relationship of the invitee and INA, place of invitation, delivery of public endorsement, and availability of a mobile unit when the invitation was delivered.

The majority of INLs in our study were men, while the majority of INAs were women. INLs had high-level positions in society, which in Rwanda are more often occupied by men. Women are less likely to be engaged in full-time employment, and thus more available for person-to-person INA promotional work. Previous studies show effective outreach agents tend to be from the communities they serve, women, and of an acceptable age for the program being implemented [23–26]. INAs in our study worked in their own communities, and though most were women, men and women were equally successful in promoting CVCT.

Not surprisingly, older INAs were more successful among cohabiting couples, while younger INAs were more successful among non-cohabiting couples. This confirms the value of promotion among age-mates. Among cohabiting couples, if an INA invited both partners together rather than an individual, crude analyses indicate a 20% greater likelihood that the couple would seek testing [19]. Other studies have also shown that targeting couples in HIV/STI programs is a successful strategy [19, 27, 28].

INAs from religious and health networks were more successful in crude analyses relative to private networks, while those from non-governmental or community-based organizations were similar. The importance of community/social network leaders in influencing attitudes and perceptions of HIV risk in sub-Saharan Africa has been reported [29–31]. The ability of religious leaders to promote HIV risk reduction has been explored, and though not significant in our multivariate analysis, was efficacious in promoting AIDS education/prevention in rural Malawi [29].

Interestingly, INAs understanding French and/or English had increased success among non-cohabiting, but decreased success among cohabiting, couples. This may be due to educational differences between older generations, most of whom did not learn French or English in school, and the younger generation who benefited from the introduction of these languages in education curricula after the 1994 genocide.

Older age of couples and longer relationship duration were each independently associated with CVCT uptake among cohabiting couples, indicating couple and relationship maturity increased joint testing. Couples who personally knew the INA, as a social acquaintance or family member, were more likely to test. This confirms the concept embodied in the term ‘influence network’ and that promotions are most successful among people who know and respect the person delivering the message.

Couples were more likely to test if invitations were delivered in the home. Other studies show that VCT/CVCT promotions occurring in couples’ homes and workplaces were more successful relative to community locations in Zimbabwe, Uganda, and Malawi [32–35]. Home-based testing is an extension of that concept [28, 33, 36, 37].

The availability of mobile units predicted CVCT in multivariate analysis, indicating they are an acceptable and convenient alternative to permanent sites. The mobile unit brought services closer to beneficiaries, overcoming a major barrier to HIV counseling and testing [36, 37].

Invitations preceded by public CVCT endorsements by community leaders were more successful. This finding had been noted in a pilot study of INA promotions [19], and prompted the addition of Influence Network Leaders (INLs) to the study design. It is likely that INLs’ senior status enhanced the impact of the promotional model and helped overcome stigma and other cultural and psychosocial barriers.

At the time of this study, though CVCT was not yet standard practice, government antenatal clinics encouraged pregnant women to invite their husbands for testing [16]. Nationwide, the proportion of pregnant women whose partners tested rose from 26% to 33% during this study. There were remarkable differences between health centers however: in one intervention neighborhood clinic, the proportion of pregnant women whose partners tested was 36% in 2004 and 75% in 2005, whereas in the other, this proportion was 1% in 2004 and 2% in 2005. In the control neighborhood, 9% and 13% of male partners were tested in 2004 and 2005. We expected spillover of our promotional activities on partner testing in ANC clinics, and this may have impacted one intervention neighborhood clinic. Clinic-level determinants – for example the clinic seeing the highest proportion of partners was the first in Kigali to implement PMTCT programs – likely superseded the impact of our community-based promotions. It is important to note that during this time, pregnant women and their partners were not routinely tested together and disclosure was not assured or documented. Though our CVCT advocacy impacted policymakers and funding agencies, counselor training guidelines specifying joint post-test counseling were not publically available until late 2007 on the CDC website and were not adopted by the Government of Rwanda until late 2009.

The overall invitation success rate in this study was 18%, similar to results from other studies. Katz, et al. reported a 16% success rate among women asked to invite partners for counseling and testing after ANC visits [38]. CVCT is not yet widely known; many couples do not know discordancy is possible, and stigma and fear of partners' reaction deter couples from testing [18]. Logistical and cultural barriers must be overcome to establish joint testing as a social norm.

Conclusion

Though CVCT has been shown to reduce HIV transmission, STIs, and unintended pregnancies among couples [9, 10, 39, 40], and despite promising research indicating the efficacy of CVCT promotional activities, widespread implementation of CVCT has not yet occurred in sub-Saharan Africa [16]. Of the 50 million Africans tested for HIV, 5% were tested with partners. This number is difficult to estimate because couples' testing is not among the common Global Fund or PEPFAR indicators.

In this study, a promotional model comprising INLs, INAs, and mobile units successfully increased the number of couples accessing CVCT. This successful model may be replicated and adapted to educate and encourage couples to attend CVCT in other countries. Our results highlight practical INA, couple, and invitation characteristics which may be explored as potential predictors of CVCT uptake in different locations. We urge other countries to begin investigating promotional activities to design effective, country-specific CVCT programs to reduce HIV transmission in the highest risk-group in sub-Saharan Africa.

Acknowledgments

We would also like to acknowledge the invaluable contributions of Erin Shutes and Suzanne Brownlow.

Sources of funding and support/sponsor roles

This work was supported by funding from the NIMH R01 66767, with contribution from the AIDS International Training and Research Program (AITRP) FIC D43 TW001042, the Social & Behavioral Core of the Emory Center for AIDS Research P30 AI050409, R01 AI40951, R01 AI51231, NICHD R01 40125, and the International AIDS Vaccine Initiative.

Reference List

1. Institut National de la Statistique du Rwanda (INSR), ORC Macro. Rwanda Demographic and Health Survey In. Calverton, MD, USA: INSR and ORC Macro; 2005.
2. WHO. Rwanda: Summary country profile for HIV/AIDS treatment scale-up. Geneva: World Health Organization; 2005.
3. Painter TM. Voluntary counseling and testing for couples: a high-leverage intervention for HIV/AIDS prevention in sub-Saharan Africa. *Soc Sci Med*. 2001; 53:1397–1411. [PubMed: 11710416]
4. World Health Organization. Preliminary Assessment. Geneva: World Health Organization; 2002. The Health Sector Response to HIV/AIDS: Coverage of Selected Services in 2001.
5. CDC. Revised recommendations for HIV screening of pregnant women. *MMWR Recomm Rep*. 2001; 50:63–85. quiz CE61-19a62-CE66-19a62. [PubMed: 11718473]
6. United States Department of State. The United States President's Emergency Plan for AIDS Relief. Washington, DC: 2011.
7. The Global Fund. The Global Fund to Fight AIDS, Tuberculosis and Malaria. Geneva, Switzerland: 2011.
8. WHO/UNAIDS/UNICEF. Towards universal access: scaling up priority HIV/AIDS interventions in the health sector. Geneva: 2007.

9. Allen S, Serufilira A, Bogaerts J, Van de Perre P, Nsengumuremyi F, Lindan C, et al. Confidential HIV testing condom promotion in Africa. Impact on HIV and gonorrhea rates. *JAMA*. 1992; 268:3338–3343. [PubMed: 1453526]
10. Allen S, Meinzen-Derr J, Kautzman M, Zulu I, Trask S, Fideli U, et al. Sexual behavior of HIV discordant couples after HIV counseling and testing. *AIDS*. 2003; 17:733–740. [PubMed: 12646797]
11. Dunkle KL, Stephenson R, Karita E, Chomba E, Kayitenkore K, Vwalika C, et al. New heterosexually transmitted HIV infections in married or cohabiting couples in urban Zambia and Rwanda: an analysis of survey and clinical data. *Lancet*. 2008; 371:2183–2191. [PubMed: 18586173]
12. Shelton JD. A tale of two-component generalised HIV epidemics. *Lancet*. 2010; 375:964–966. [PubMed: 20304227]
13. Allen S, Lindan C, Serufilira A, Van de Perre P, Rundle AC, Nsengumuremyi F, et al. Human immunodeficiency virus infection in urban Rwanda. Demographic and behavioral correlates in a representative sample of childbearing women. *JAMA*. 1991; 266:1657–1663. [PubMed: 1886188]
14. Roth DL, Stewart KE, Clay OJ, van Der Straten A, Karita E, Allen S. Sexual practices of HIV discordant and concordant couples in Rwanda: effects of a testing and counselling programme for men. *Int J STD AIDS*. 2001; 12:181–188. [PubMed: 11231872]
15. Bender D, Pitkin K. Bridging the gap: the village health worker as the cornerstone of the primary health care model. *Social Science & Medicine*. 1987; 24:515–528. [PubMed: 3589747]
16. Conkling M, Shutes EL, Karita E, Chomba E, Tichacek A, Sinkala M, et al. Couples' voluntary counselling and testing and nevirapine use in antenatal clinics in two African capitals: a prospective cohort study. *J Int AIDS Soc*. 2010; 13:10. [PubMed: 20230628]
17. Telfair J, Mulvihill BA. Bridging Science and Practice: The Integrated Model of Community Based Evaluation (IMCBE). *Journal of Community Practice*. 2000; 7:37–65. June 2000.
18. Kelley A, Karita E, Sullivan P, Katangulua F, Chomba E, Carael M, et al. Knowledge and perceptions of couples' voluntary counseling and testing in urban Rwanda and Zambia: a cross-sectional household survey. *PLoS One*. 2011; 6(5):e19573. [PubMed: 21573068]
19. Allen S, Karita E, Chomba E, Roth DL, Telfair J, Zulu I, et al. Promotion of couples' voluntary counselling and testing for HIV through influential networks in two African capital cities. *BMC Public Health*. 2007; 7:349. [PubMed: 18072974]
20. Chomba E, Allen S, Kanweka W, Tichacek A, Cox G, Shutes E, et al. Evolution of couples' voluntary counseling and testing for HIV in Lusaka, Zambia. *Journal of Acquired Immune Deficiency Syndromes: JAIDS*. 2008; 47:108–115.
21. McKenna SL, Muyinda GK, Roth D, Mwali M, Ng'andu N, Myrick A, et al. Rapid HIV testing and counseling for voluntary testing centers in Africa. *AIDS*. 1997; 11(Suppl 1):S103–S110. [PubMed: 9376093]
22. Boeras D, Luisi N, Karita E, Mwananyanda L, McKinney S, Sharkey T, et al. Indeterminate and discrepant rapid HIV test results in couples' HIV testing and counseling centers in Africa. *JAIDS*. In review. 2010
23. Ferrell BJAG. Community development and health project: a 5-year (1995–1999) experience in Mozambique, Africa. *International Nursing Review*. 2002; 49:27–37. [PubMed: 11930954]
24. Kaseje DC, Spencer HC, Sempebwa EK. Characteristics and functions of community health workers in Saradidi, Kenya. *Annals of Tropical Medicine & Parasitology*. 1987; 81(Suppl 1):56–66. [PubMed: 3689038]
25. Pagnoni F, Convelbo N, Tiendrebeogo J, Cousens S, Esposito F. A community-based programme to provide prompt and adequate treatment of presumptive malaria in children. *Transactions of the Royal Society of Tropical Medicine & Hygiene*. 1997; 91:512–517. [PubMed: 9463653]
26. Stekelenburg J, Kyanamina SS, Wolffers I. Poor performance of community health workers in Kalabo District, Zambia. *Health Policy*. 2003; 65:109–118. [PubMed: 12849910]
27. El-Bassel N, Witte SS, Gilbert L, Wu E, Chang M, Hill J, et al. The efficacy of a relationship-based HIV/STD prevention program for heterosexual couples. *Am J Public Health*. 2003; 93:963–969. [PubMed: 12773363]

28. Were WA, Mermin JH, Wamai N, Awor AC, Bechange S, Moss S, et al. Undiagnosed HIV infection and couple HIV discordance among household members of HIV-infected people receiving antiretroviral therapy in Uganda. *Journal of Acquired Immune Deficiency Syndromes: JAIDS*. 2006; 43:91–95.
29. Trinitapoli J. Religious Responses to AIDS in Sub-Saharan Africa: An Examination of Religious Congregations in Rural Malawi *Review of Religious Research*. 2006; 47:253–270.
30. Kohler HP, Behrman JR, Watkins SC. Social networks and HIV/AIDS risk perceptions. *Demography*. 2007; 44:1–33. [PubMed: 17461334]
31. Valente TW, Hoffman BR, Ritt-Olson A, Lichtman K, Johnson CA. The effects of a social network method for group assignment strategies on peer led tobacco prevention programs in schools. *American Journal of Public Health*. 2003; 93:1837–1843. [PubMed: 14600050]
32. Angotti, N.; Gaydosh, L.; Kimchi, E.; Thornton, R.; Watkins, S.; Yeatman, S. American Sociological Association Annual Conference. New York, NY: 2007. The Fear Factor in HIV Testing: Local Reactions to Door-to-Door Rapid Blood Testing for HIV in Rural Malawi.
33. Fylkesnes K, Siziya S. A randomized trial on acceptability of voluntary HIV counselling and testing. *Tropical Medicine and International Health*. 2004; 9:566–572. [PubMed: 15117300]
34. Corbett E, Dauya E, Matambo R, Cheung Y, Makamure B, Bassett M, et al. Uptake of workplace HIV counselling and testing: a cluster-randomised trial in Zimbabwe. *PLoS Med*. 2006; 3:e238. [PubMed: 16796402]
35. Wolff B, Nyanzi B, Katongole G, Ssesanga D, Ruberantwari A, Whitworth J. Evaluation of a home-based voluntary counselling and testing intervention in rural Uganda. *Health Policy Plan*. 2005; 20:109–116. [PubMed: 15746219]
36. Angotti N, Bula A, Gaydosh L, Kimchi E, Thornton R, Yeatman S. Increasing the acceptability of HIV counseling and testing with three C's: Convenience, confidentiality and credibility. *Social Science & Medicine*. 2009; 68:2263–2270. [PubMed: 19375208]
37. Matovu JK, Makumbi FE. Expanding access to voluntary HIV counselling and testing in sub-Saharan Africa: alternative approaches for improving uptake, 2001–2007. *Trop Med Int Health*. 2007; 12:1315–1322. [PubMed: 17949401]
38. Katz DA, Kiarie JN, John-Stewart GC, Richardson BA, John FN, Farquhar C. Male perspectives on incorporating men into antenatal HIV counseling and testing. *PLoS One*. 2009; 4:e7602. [PubMed: 19881884]
39. King R, Allen S, Serufilira A, Karita E, Van de Perre P. Voluntary confidential HIV testing for couples in Kigali, Rwanda. *AIDS*. 1993; 7:1393–1394. [PubMed: 8267917]
40. Allen S, Serufilira A, Gruber V, Kegeles S, Van de Perre P, Carael M, et al. Pregnancy and contraception use among urban Rwandan women after HIV testing and counseling. *Am J Public Health*. 1993; 83:705–710. [PubMed: 8484453]

Figure 1.
Sequence of INA recruiting, couple invitation, and data collection and analysis plan

Table 1
INL characteristics and INA characteristics by invitations distributed, success rate, and couple cohabitation status

	INL No. (%)	INA No. (%)	Invitations Distributed	Success Rate (%)	Invitations given to cohabiting couples (%)	Couples tested who are cohabiting (%)	Success Rate (%)	Cohabiting Couples	Non- Cohabiting Couples
Total	26 (100)	118 (100)	24,991	18%	60%	63%	19%	19%	17%
Network									
Private	6 (23)	29 (25)	6094	16%	56%	61%	17%	17%	15%
Religious	8 (31)	33 (28)	7260	20%	59%	58%	20%	20%	20%
Health	4 (15)	29 (25)	6093	19%	63%	69%	21%	21%	16%
CBO/NGO	8 (31)	27 (23)	5544	17%	61%	64%	18%	18%	15%
Gender									
Man	19 (73)	35 (30)	7710	18%	61%	63%	18%	18%	16%
Woman	7 (27)	83 (70)	17281	18%	59%	62%	19%	19%	17%
Relationship status									
Married/dating	21 (81)	57 (48)	12,101	19%	56%	58%	20%	20%	18%
Widow	0 (0)	25 (21)	4563	15%	61%	64%	16%	16%	14%
Divorced	0 (0)	5 (4)	5356	18%	63%	68%	20%	20%	16%
Single	4 (15)	23 (19)	1054	14%	70%	75%	15%	15%	12%
Missing	1 (4)	8 (7)	1917	19%	60%	66%	21%	21%	16%
Occupation									
Unskilled manual labor	4 (15)	25 (21)	5684	16%	64%	72%	18%	18%	13%
Agricultural	0 (0)	9 (8)	2016	23%	68%	67%	22%	22%	23%
Sales/service	8 (31)	37 (31)	7851	17%	59%	63%	18%	18%	16%
Professional	14 (54)	19 (16)	4044	20%	56%	55%	19%	19%	20%
Do not work for money	0 (0)	25 (21)	4706	19%	55%	57%	19%	19%	18%
Missing	0 (0)	3 (3)	690	18%	50%	66%	23%	23%	12%
Understand Kinyarwanda									
Yes	26 (100)	110 (93)	23,046	18%	59%	62%	19%	19%	17%
No	0 (0)	8 (7)	1945	15%	61%	68%	17%	17%	12%

	INL No. (%)	INA No. (%)	Invitations Distributed	Success Rate (%)	Invitations given to cohabiting couples (%)	Couples tested who are cohabiting (%)	Success Rate (%)	Cohabiting Couples	Non- Cohabiting Couples
Understand French &/or English									
Yes	18 (69)	45 (38)	9577	18%	57%	58%	19%	19%	18%
No	8 (31)	73 (62)	15,414	18%	61%	65%	19%	19%	16%
Housing									
Provided by employer (free)	2 (8)	1 (1)	240	56%	41%	43%	59%	59%	55%
Rental home	11 (42)	30 (25)	6194	20%	54%	54%	19%	19%	20%
Free housing by other means	0 (0)	5 (4)	770	21%	56%	59%	22%	22%	20%
Own home	13 (50)	82 (70)	17787	17%	62%	67%	18%	18%	14%
Ever tested for HIV									
Yes with partner	13 (50)	42 (36)	9239	19%	57%	60%	19%	19%	18%
Yes alone	6 (23)	72 (61)	15,030	18%	61%	64%	19%	19%	17%
No	7 (27)	4 (3)	722	14%	49%	66%	19%	19%	10%

Table 2
Bivariate association between INA characteristics and couples' testing by couples' cohabitation status

INA characteristics	All Couples		Cohabiting Couples		Non-cohabiting Couples	
	Odds Ratio (95% CI)	P Value	Odds Ratio (95% CI)	P Value	Odds Ratio (95% CI)	P Value
Network						
Private	Ref		Ref		Ref	
Religious	1.30 (1.19–1.42)	<.001	1.22 (1.09–1.36)	<.001	1.34 (1.17–1.53)	<.001
Health	1.20 (1.09–1.31)	<.001	1.36 (1.22–1.52)	<.001	0.91 (0.79–1.06)	0.21
CBO/NGO	1.05 (0.95–1.15)	0.37	1.11 (0.99–1.25)	0.08	0.94 (0.81–1.09)	0.42
Gender						
Male	Ref		Ref		Ref	
Female	1.05 (0.98–1.13)	0.17	1.02 (0.94–1.11)	0.65	1.09 (0.98–1.21)	0.12
Age (per year increase)	1.00 (0.996–1.004)	0.92	1.01 (1.002–1.012)	0.004	0.99 (0.983–0.995)	<.001
Years living in Kigali (per year increase)	1.01 (1.00–1.01)	<.001	1.00 (0.999–1.01)	0.13	1.01 (1.004–1.013)	<.001
Relationship status						
Other (divorced, widowed, single)	Ref		Ref		Ref	
Married/dating	1.15 (1.07–1.22)	<.001	0.98 (0.90–1.06)	0.54	1.43 (1.30–1.58)	<.001
Occupation						
Unskilled manual labor	Ref		Ref		Ref	
Agricultural	1.52 (1.34–1.72)	<.001	1.36 (1.18–1.58)	<.001	1.69 (1.37–2.08)	<.001
Sales/service	1.06 (0.97–1.16)	0.23	0.91 (0.81–1.01)	0.07	1.42 (1.22–1.66)	<.001
Professional	1.27 (1.14–1.41)	<.001	0.92 (0.81–1.05)	0.22	2.06 (1.75–2.43)	<.001
Do not work for money	1.19 (1.08–1.32)	<.001	0.92 (0.81–1.04)	0.16	1.83 (1.56–2.16)	<.001
Understand Kinyarwanda						
No	Ref		Ref		Ref	
Yes	1.24 (1.09–1.41)	<.001	1.10 (0.95–1.28)	0.21	1.48 (1.19–1.83)	<.001
Understand French &/or English						
No	Ref		Ref		Ref	
Yes	1.04 (0.98–1.11)	0.22	0.91 (0.84–0.99)	0.03	1.28 (1.16–1.41)	<.001
Housing						

INA characteristics	All Couples			Cohabiting Couples			Non-cohabiting Couples		
	Odds Ratio (95% CI)	P Value		Odds Ratio (95% CI)	P Value		Odds Ratio (95% CI)	P Value	
Other housing (rental, free)	Ref			Ref			Ref		
Own home	0.77 (0.72–0.83)	<.001		1.03 (0.94–1.12)	0.55		0.54 (0.49–0.60)	<.001	
Ever tested for HIV									
No	Ref			Ref			Ref		
Yes alone	1.32 (1.06–1.63)	0.01		1.25 (0.97–1.62)	0.08		1.34 (0.95–1.90)	0.10	
Yes with partner	1.37 (1.10–1.69)	0.01		1.19 (0.92–1.55)	0.18		1.58 (1.12–2.24)	0.01	

INA: influential network agent
CBO/NGO: Community-based/non-governmental organization

Table 3

Bivariate association between couple and invitation characteristics and couples' testing

	All couples	Odds Ratio (95% CI)	P Value
Couple Characteristics			
Age of man (per year increase), mean (SD), y	31 (10)	1.01 (1.01–1.02)	<.001
Age of woman (per year increase), mean (SD), y	26 (8)	1.01 (1.01–1.02)	<.001
Relationship of couple, No. (%)			
Not cohabiting	10,098 (40)	Ref	
Cohabiting	14,874 (60)	1.20 (1.10–1.30)	<.001
Years of relationship (per year increase), mean (SD)	6 (6)	1.02 (1.02–1.03)	<.001
Number of children, mean (SD)	1 (2)	1.02 (1.00–1.04)	0.10
Invitation Characteristics			
Invitee (1st contact), No. (%)			
Woman	7176 (29)	Ref	
Man	11,656 (47)	0.94 (0.86–1.03)	0.20
Couple	6148 (25)	1.20 (1.07–1.36)	0.003
Who initiated contact, No. (%)			
INA	24,408 (98)	Ref	
Couple	79 (0.3)	1.15 (0.69–1.92)	0.58
Man	333 (1)	1.20 (0.93–1.56)	0.16
Woman	156 (1)	1.72 (1.08–2.76)	0.02
Relationship to INA, No. (%)			
Just met/unknown	9309 (37)	Ref	
Co-worker	3260 (13)	1.08 (0.90–1.30)	0.41
Family	488 (2)	1.66 (1.12–2.48)	0.01
Social acquaintance (neighbor, friend, church member)	11911 (48)	1.51 (1.34–1.71)	<.001
Place of invitation, No. (%)			
Community [*]	4762 (19)	Ref	
Couple home	14,742 (59)	1.23 (1.06–1.44)	0.007
INA home	884 (4)	1.86 (1.45–2.39)	<.001
Couple or INA work	4583 (18)	1.03 (0.88–1.22)	0.70
Public endorsement, No. (%)			
No	21,834 (87)	Ref	
Yes	3144 (13)	1.21 (1.04–1.41)	0.01
Degree of difficulty delivering invitation, No. (%)			
Difficult/somewhat difficult	4629 (19)	Ref	
Not difficult	20,351 (81)	1.02 (0.90–1.16)	0.72
Mobile unit present at time of invitation, No. (%)			
No	12,311 (50)	Ref	

	All couples	Odds Ratio (95% CI)	P Value
Yes	12,371 (50)	1.58 (1.12–2.24)	0.009
Neighborhood of invitation, No. (%)			
Neighborhood 1	12,157 (49)	Ref	
Neighborhood 2	12,834 (51)	1.07 (0.82–1.39)	0.62

* Community: church/mosque, clinic, market, street/public place, social gathering

INA: influential network agent

Table 4

Multivariate model of INA, couple, and invitation level characteristics associated with couples' testing

INA characteristics	All Couples		Cohabiting Couples		Non-cohabiting Couples	
	Odds Ratio (95% CI)	P Value	Odds Ratio (95% CI)	P Value	Odds Ratio (95% CI)	P Value
Network						
Private	Ref		Ref		Ref	
Religious	1.01(0.71–1.45)	0.94	0.97 (0.65–1.44)	0.88	1.14 (0.74–1.77)	0.54
Health	0.87 (0.59–1.30)	0.50	0.86 (0.57–1.29)	0.46	1.04 (0.63–1.73)	0.87
CBO/NGO	0.85 (0.58–1.26)	0.43	0.82 (0.55–1.24)	0.35	0.89 (0.56–1.40)	0.60
Years living in Kigali (per year increase)	0.998 (0.99–1.01)	0.74	1.00 (0.98–1.01)	0.55	1.00 (0.99–1.01)	0.74
Age (per year increase)	1.00 (0.98–1.02)	0.94	1.00 (0.98–1.02)	0.996	0.99 (0.97–1.01)	0.42
Relationship status						
Other (divorced, widowed, single)	Ref		Ref		Ref	
Married/dating	1.17 (0.87–1.56)	0.30	1.15 (0.86–1.53)	0.35	1.43 (0.95–2.14)	0.09
Occupation						
Unskilled manual labor	Ref		Ref		Ref	
Agricultural	1.24 (0.71–2.16)	0.45	1.03 (0.61–1.75)	0.91	1.98 (0.87–4.47)	0.10
Professional	0.95 (0.56–1.63)	0.86	0.96 (0.55–1.69)	0.89	1.47 (0.81–2.66)	0.21
Sales/service	1.01 (0.67–1.51)	0.97	0.91 (0.60–1.39)	0.68	1.63 (1.00–2.65)	0.05
Do not work for money	1.00 (0.70–1.42)	0.99	0.91 (0.62–1.32)	0.61	1.69 (1.05–2.72)	0.03
Understand Kinyarwanda						
No	Ref		Ref		Ref	
Yes	1.07 (0.80–1.43)	0.65	1.08 (0.75–1.54)	0.68	1.01 (0.64–1.58)	0.97
Understand French and/or English						
No	Ref		Ref		Ref	
Yes	1.17 (0.85–1.61)	0.33	1.10 (0.78–1.55)	0.60	1.36 (0.94–1.96)	0.10
Housing						
Other housing (rental, free)	Ref		Ref		Ref	
Own home	0.75 (0.54–1.04)	0.09	0.76 (0.54–1.06)	0.11	0.71 (0.51–0.97)	0.03
Ever tested for HIV						

INA characteristics	All Couples		Cohabiting Couples		Non-cohabiting Couples	
	Odds Ratio (95% CI)	P Value	Odds Ratio (95% CI)	P Value	Odds Ratio (95% CI)	P Value
No/Yes alone	Ref		Ref		Ref	
Yes with partner	0.96 (0.70–1.31)	0.78	0.95 (0.70–1.28)	0.73	0.75 (0.47–1.17)	0.20
Couple Characteristics						
Age of man (per year increase)	1.00 (0.99–1.01)	0.59	1.02 (1.01–1.03)	<.001	0.97 (0.95–0.99)	0.01
Relationship of couple						
Not cohabiting	Ref		n/a		n/a	
Cohabiting	1.10 (0.99–1.22)	0.054				
Years of current relationship (per year increase)	1.02 (1.01–1.03)	0.004	1.03 (1.02–1.04)	<.001	0.58 (0.54–0.63)	<.001
Invitation Characteristics						
Invitee (1st contact)						
Individual (Woman/Man)	Ref		Ref		Ref	
Couple	1.06 (0.93–1.21)	0.36	1.18 (1.04–1.35)	0.01	0.78 (0.59–1.03)	0.08
Relationship to INA						
Just met/unknown	Ref		Ref		Ref	
Co-worker	1.07 (0.90–1.27)	0.46	1.01 (0.83–1.23)	0.93	1.30 (0.95–1.78)	0.10
Social acquaintance (neighbor, friend, church member, family member)	1.42 (1.24–1.62)	<.001	1.27 (1.12–1.44)	<.001	1.68 (1.34–2.11)	<.001
Place of invitation						
Other (Community* or INA/couple work)	Ref		Ref		Ref	
INA or couple home	1.12 (0.99–1.27)	0.06	1.25 (1.09–1.44)	0.002	1.03 (0.84–1.27)	0.79
Public endorsement						
No	Ref		Ref		Ref	
Yes	1.29 (1.09–1.54)	0.004	1.31 (1.10–1.57)	0.003	1.54 (1.19–1.98)	0.001
Mobile unit present at time of invitation						
No	Ref		Ref		Ref	
Yes	1.44 (1.03–2.01)	0.03	1.47 (1.14–1.91)	0.003	1.09 (0.77–1.53)	0.64

* Community: church/mosque, clinic, market, street/public place, social gathering

CBO/NGO: Community-based/non-governmental organization

INA: influential network agent