

Promotion of couples' voluntary HIV counselling and testing in Lusaka, Zambia by influence network leaders and agents

Kristin M Wall,^{1,2,4} William Kilembe,^{1,2,3} Azhar Nizam,^{1,2,5} Cheswa Vwalika,^{1,2,3} Michelle Kautzman,^{1,2,3} Elwyn Chomba,^{1,2,3,6} Amanda Tichacek,^{1,2} Gurkiran Sardar,^{1,2,3,8} Deborah Casanova,^{1,2,3} Faith Henderson,^{1,2,3} Joseph Mulenga,^{1,2,3,7} David Kleinbaum,^{1,2,4} Susan Allen^{1,2}

To cite: Wall KM, Kilembe W, Nizam A, *et al.* Promotion of couples' voluntary HIV counselling and testing in Lusaka, Zambia by influence network leaders and agents. *BMJ Open* 2012;**2**:e001171. doi:10.1136/bmjopen-2012-001171

► Prepublication history for this paper are available online. To view these files please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2012-001171>).

Received 20 March 2012
Accepted 20 July 2012

This final article is available for use under the terms of the Creative Commons Attribution Non-Commercial 2.0 Licence; see <http://bmjopen.bmj.com>

For numbered affiliations see end of article.

Correspondence to
Kristin M Wall;
kmwall@emory.edu

ABSTRACT

Objectives: Hypothesising that couples' voluntary counselling and testing (CVCT) promotions can increase CVCT uptake, this study identified predictors of successful CVCT promotion in Lusaka, Zambia.

Design: Cohort study.

Setting: Lusaka, Zambia.

Participants: 68 influential network leaders (INLs) identified 320 agents (INAs) who delivered 29 119 CVCT invitations to heterosexual couples.

Intervention: The CVCT promotional model used INLs who identified INAs, who in turn conducted community-based promotion and distribution of CVCT invitations in two neighbourhoods over 18 months, with a mobile unit in one neighbourhood crossing over to the other mid-way through.

Primary outcome: The primary outcome of interest was couple testing (yes/no) after receipt of a CVCT invitation. INA, couple and invitation characteristics predictive of couples' testing were evaluated accounting for two-level clustering.

Results: INAs delivered invitations resulting in 1727 couples testing (6% success rate). In multivariate analyses, INA characteristics significantly predictive of CVCT uptake included promoting in community-based (adjusted OR (aOR)=1.3; 95% CI 1.0 to 1.8) or health (aOR=1.5; 95% CI 1.2 to 2.0) networks versus private networks; being employed in the sales/service industry (aOR=1.5; 95% CI 1.0 to 2.1) versus unskilled manual labour; owning a home (aOR=0.7; 95% CI 0.6 to 0.9) versus not; and having tested for HIV with a partner (aOR=1.4; 95% CI 1.1 to 1.7) or alone (aOR=1.3; 95% CI 1.0 to 1.6) versus never having tested. Cohabiting couples were more likely to test (aOR=1.4; 95% CI 1.2 to 1.6) than non-cohabiting couples. Context characteristics predictive of CVCT uptake included inviting couples (aOR=1.2; 95% CI 1.0 to 1.4) versus individuals; the woman (aOR=1.6; 95% CI 1.2 to 2.2) or couple (aOR=1.4; 95% CI 1.0 to 1.8) initiating contact versus the INA; the couple being socially acquainted with the INA (aOR=1.6; 95% CI 1.4 to 1.9) versus having just met; home invitation delivery (aOR=1.3; 95% CI 1.1 to 1.5)

ARTICLE SUMMARY

Article focus

- Given preliminary findings from Zambia and Rwanda suggesting community-based promotion of couples' voluntary counselling and testing (CVCT) is effective, we hypothesise that predictors of successful promotions can be identified to increase CVCT uptake in Lusaka, Zambia.
- This study evaluated the ability of community-based activities to promote CVCT and identified predictors of CVCT uptake in Lusaka, Zambia.

Key messages

- Here, we not only demonstrated the feasibility of CVCT promotions using influential network agents and leaders (INAs and INLs) to promote CVCT, but also identified INA-level, couple-level and invitation-level predictors of CVCT uptake.
- The predictors of CVCT uptake included: recruiting INAs who have tested with partners, focusing invitations on INA acquaintances, issuing invitations to couples and in a discreet location, and utilising INAs from non-governmental and health networks.

Strengths and limitations of this study

- These predictors can be used to enhance CVCT promotions in Zambia and may be extended as a framework to other locales, with adaptation based on location-specific predictors of CVCT promotions.
- Country-specific differences in CVCT promotions indicate that more research into site-specific predictors of CVCT may be necessary for successful CVCT promotions in other locales.

versus elsewhere; and easy invitation delivery (aOR=1.8; 95% CI 1.4 to 2.2) versus difficult as reported by the INA.

Conclusions: This study demonstrated the ability of influential people to promote CVCT and identified agent, couple and context-level factors associated with CVCT uptake in Lusaka, Zambia. We encourage the

development of CVCT promotions in other sub-Saharan African countries to support sustained CVCT dissemination.

BACKGROUND

In 2009, 68% of the global HIV-positive population resided in sub-Saharan Africa, equating to roughly 22.5 million cases. Zambia has one of the largest HIV burdens, with roughly 980 000 prevalent and 76 000 incident cases in 2009,¹ and HIV prevalence roughly twice as high in urban (20%) versus rural (<10%) areas.²

Heterosexual transmission is the primary cause of incident HIV infections in sub-Saharan Africa where discordant couples (an HIV+ and HIV- partner) in long-term relationships represent the largest group at-risk for HIV.¹⁻³ In urban Zambia, roughly 60% of new infections occurred between married/cohabiting heterosexual couples,³ and 17% of pregnant couples in Lusaka were discordant.⁴

Knowledge of HIV serostatus is critical for prevention of transmission. According to the 2007 Zambia Demographic and Health Survey, although most adults know where to receive an HIV test, only 35% of women and 20% of men have ever tested and received results.² Voluntary HIV counselling and testing (VCT) is an evidence-based strategy to increase serostatus awareness, decrease high-risk behaviour and decrease transmission.⁵ Couples' VCT (CVCT), in which both partners are tested and mutually disclose results, addresses issues with disclosure, allows for risk-reduction planning based on partner serostatus, and decreases high-risk behaviour.⁶⁻⁸ However, though CVCT effectively targets the highest at-risk group in sub-Saharan Africa, it has not been widely disseminated due to lack of demand and supply, and lack of funding. Lack of demand primarily results from insufficient knowledge about the possibility of couple serodiscordance and CVCT services.⁸⁻¹¹

The Zambia-Emory HIV Research Project (ZEHRP), based in Lusaka, provides CVCT services. ZEHRP and other groups have shown that clinic and community-based CVCT promotions can increase CVCT awareness and demand.^{4, 11-14} Social networks and community leaders are critical in changing perceptions towards HIV/AIDS and other health issues in sub-Saharan Africa.¹⁵⁻¹⁸ At ZEHRP, CVCT promotional efforts are directed by influential network leaders (INLs) and agents (INAs), based on the Social Networks and Social Support Theory.¹⁹ This study assessed the ability of INLs and INAs to promote CVCT and identified predictors of CVCT uptake in Lusaka.

METHODS

INL and INA recruitment and training

ZEHRP CVCT promotions maximise programme impact by utilising two existing social networks levels—INLs and INAs. INL and INA recruitment and training methods

are described elsewhere.¹³⁻²⁰ Briefly, INLs were identified from CVCT consensus meetings and national/city-wide umbrella referrals from four social networks (faith-based/religious, health, private and community-based/non-governmental organisations (CBOs/NGOs)). INLs identified INA candidates from their respective networks, and final selection was made after interviewing with experienced ZEHRP counsellors. INLs and INAs completed IRB-approved written informed consents, completed demographic questionnaires and selected a network category that best described their role when promoting CVCT. Enrolled INAs received 4-day training in HIV/AIDS health advocacy/outreach, social networking, CVCT promotions and observation of successful door-to-door ZEHRP promotional strategies. During training, INLs and INAs were offered CVCT or VCT.

CVCT promotions

CVCT promotional activities took place from July 2004 to December 2005 in two randomly selected neighbourhoods as described elsewhere.²¹ Briefly, of eight neighbourhoods assessed as potential sites, two were selected based on similar population size, infrastructure and with consideration of geographic distance to minimise spill-over effects. CVCT promotions and services were implemented in these neighbourhoods, and a mobile unit operated in one neighbourhood and crossed over to the other mid-way through the study. Given the catchment areas of these two neighbourhoods (99 280 and 85 022 individuals), it was assumed that couples would rarely receive multiple invitations. INAs distributed invitations to couples or individuals within their neighbourhoods that detailed CVCT facility directions and procedures. Couples could be cohabiting or non-cohabiting. Invitations included a unique ID, INA identifier and a receipt portion that the INA retained and submitted bi-weekly. The receipt portion contained the invitation ID and space to record the date, time, place of invitation, relationship of the INA and recipient, recipient description (man, woman or couple), recipients' age(s), residence, marital status and INA's perception of the difficulty of invitation delivery.

Before 18 March 2005, INAs received \$0.21/invitation issued and an additional \$4.20/couple attending CVCT. Beginning 19 March 2005, payment/invitation was reduced to \$0.11 and payment/couple attending CVCT was increased to \$5.25 to deter fraudulent completion of invitation receipts. For perspective, Purchasing Power Parity in Zambia, an adjusted measure of per-capita-income number, is \$1500/year,²² and the proportion of Zambians living on less than \$1/day is 63.6%.²³ In addition to fixed CVCT sites, which could serve 30 couples/day, a mobile HIV testing unit, which could serve an additional 30 couples/day, was available for 9 months in one neighbourhood and then 9 months in the other. Mobile testing sites were selected based on facility (churches, schools and community centres) availability.

CVCT procedures

CVCT procedures are described elsewhere.¹³ Briefly, couples participate in group counselling, joint pretest counselling and, for those testing, confidential informed consent procedures, phlebotomy, rapid HIV testing,²⁴ and joint post-test counselling and test result delivery. CVCT services were free and transportation to testing sites was reimbursed. Invitation receipts were collected from INA-invited couples and the invitation ID was linked to the couple ID number. The study was approved by the Emory University IRB and the University of Zambia Research Ethics committee. Informed consent was obtained from all study participants.

Statistical analysis

Counts (percentages) for categorical variables and means (SD) for continuous variables were calculated for INL-level, INA-level, couple-level and invitation-level characteristics. Number of invitations distributed was tabulated by INA characteristics as were success rates (the number couples tested/number invitations distributed). Analyses were stratified by couple cohabitation status to identify differences in CVCT uptake and predictors of success. INAs not achieving $\geq 1.5\%$ success were excluded from analyses to prevent the inclusion of INAs systematically returning fraudulent receipts.

Crude ORs, 95% CIs and *p* values evaluated associations between INA-level characteristics predictive of successful invitations. Generalised estimating equation (GEE) methods evaluated the association between couple-level and invitation-level characteristics predictive of successful invitations. Since couple-level and invitation-level data are clustered at two levels, within-individual INAs and INLs, GEE methods accounted for non-independence of observations.

INA-level, couple-level and invitation-level variables significant (Bonferroni corrected *p* value=0.002) in univariate analyses were entered into a multivariate logistic regression model, and the variables were examined for multi-collinearity. GEE methods accounted for clustering of couple-level and invitation-level characteristics within individual INAs and INLs. We fit the marginal multilevel logistic regression model using PROC GENMOD. GEE analysis methods with an exchangeable correlation structure accounted for two-level clustering of couple-level and invitation-level characteristics within individual INAs and INLs. We hypothesised a priori that an exchangeable correlation structure would be appropriate since couples within a cluster should not be increasingly/decreasingly correlated. We also considered other correlation structures, such as unstructured. Data analysis was conducted with SAS V.9.2 (North Carolina, USA).

RESULTS

INL characteristics

Sixty-eight INLs were recruited from CBOs/NGOs, faith-based, health and private sector networks. Average INL

age was 45 (IQR=36–52), and 68% were men. Average years living in Lusaka was 25 (IQR=15–34), and 72% were married. Almost all INLs understood Nyanja and/or Bemba or English, roughly half owned their home and most had previously tested for HIV (table 1).

INA characteristics associated with couples' testing

INLs recruited 320 INAs (excluding 70 INAs with <1.5% success), and overall INAs distributed 29 119 invitations with 1727 couples tested for an average of 91 invites/INA and five couples tested/INA. INAs affiliated to CBOs/NGOs distributed more than average invitations/INA and were more likely to successfully invite cohabiting couples relative to private network INAs. Health network INAs also distributed a high number of average invitations/INA and were more successful among all couples relative to private network INAs (tables 1 and 2).

Most INAs were women, and performance with respect to invitations delivered, success rates and average number of couples tested was similar by gender (table 1). The average INA age was 37 (IQR=29–44), and older INAs were significantly more successful among cohabiting, but less successful among non-cohabiting, couples relative to younger INAs (table 2). The average number of years living in Lusaka was 21 (IQR=11–30), and years living in Lusaka significantly predicted successful invitation among cohabiting couples (table 2).

Married INAs were significantly more successful among cohabiting couples relative to divorced, widowed or single INAs (table 2). Divorced INAs had very low success rates among non-cohabiting couples (table 1). Among INAs with a partner, years of current relationship had a similar effect as age, with longer unions associated with significantly decreased success among non-cohabiting couples.

Fifty one per cent of INAs were sales/service industry employees, and these INAs were significantly more successful among cohabiting and non-cohabiting couples relative to unskilled manual labourers. Professional and agricultural sector employees were also more successful among non-cohabiting couples (table 2). Eighty per cent of INAs could read English (table 1), and this was associated with successful invitations among non-cohabiting couples only.

Over half of INAs rented their home. The 38% who owned a home were less successful than those who rented or lived in housing provided by others; with stratification this remained significant only among cohabiting couples (table 2). Two per cent of INAs had housing provided by an employer and were substantially more successful among cohabiting couples (table 1).

Only 57% of INAs had tested for HIV with a partner (22%) or alone (35%) (table 1). INAs testing for HIV with a partner were more successful among all couples, and testing alone was associated with higher success among non-cohabiting couples relative to never testing (table 2).

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

	INL (N=68)		INA (N=320)		Invitations distributed	Couples tested	Average invites/ INA	Average couples tested/INA	Success rate (%)	% invitations given to cohabiting couples	% couples tested who are cohabiting	Success rate (%)	
												Cohab couples	Non-cohab couples
	N	%	N	%									
Total	68		320		29119	1727	91	5	6	81	87	6	4
Network													
Private	16	24	73	23	5592	302	77	4	5	79	82	6	3
Religious	19	28	62	19	5530	282	89	5	5	85	95	6	4
Health	12	18	95	30	9529	617	100	6	6	80	86	7	5
CBOs/NGOs	21	31	90	28	8468	526	94	6	6	82	87	7	4
Gender													
Man	46	68	131	41	11620	700	89	5	6	81	85	6	5
Woman	22	32	189	59	17499	1027	93	5	6	82	88	6	4
Relationship status													
Married	49	72	208	65	18814	1178	90	6	6	82	88	7	4
Divorced	5	7	21	7	2033	86	97	4	4	82	94	5	1
Single	7	10	38	12	2902	131	76	3	5	74	83	5	3
Widow	7	10	45	14	4212	303	94	7	7	83	84	7	7
Missing	0	0	8	3	1158	29	145	4	3	78	79	3	2
Occupation													
Professional/ technical/ managerial	28	41	68	21	5605	330	82	5	6	80	81	6	5
Sales/service	22	32	163	51	11462	793	70	5	7	81	88	7	5
Agricultural	1	1	6	2	739	43	123	7	6	75	77	6	5
Unskilled manual labor	12	18	42	13	5352	278	127	7	5	84	90	6	3
Do not work for money	2	3	33	10	4912	253	149	8	5	82	90	6	3
Missing	3	4	8	3	1049	30	131	4	3	82	100	3	0
Read English													
Yes	64	94	265	83	23744	1439	90	5	6	81	86	6	4
No	4	6	55	17	5375	288	98	5	5	82	92	6	2
Housing													
Provided by employer (free)	5	7	6	2	372	38	62	6	10	83	95	12	3
Rental home	22	32	166	52	16341	985	98	6	6	81	86	6	4
Free housing by other means	10	15	26	8	1611	113	62	4	7	80	89	8	4

Continued

Table 1 Continued

	INL (N=68)		INA (N=320)		Invitations distributed	Couples tested	Average invites/INA	Average couples tested/INA	Success rate (%)	% invitations given to cohabiting couples	% couples tested who are cohabiting	Success rate (%)	
	N	%	N	%								Cohab couples	Non-cohab couples
Own home	30	44	120	38	10583	585	88	5	6	82	87	6	4
Missing	1	1	2	1	212	6	106	3	3	62	100	5	0
Ever tested for HIV													
Yes with partner	41	60	71	22	6274	303	88	4	5	82	93	5	2
Yes alone	14	21	113	35	10424	608	92	5	6	81	87	6	4
No	13	19	135	42	12207	802	90	6	7	81	85	7	5
Missing	0	0	1	0	214	14	214	14	7	86	86	7	7

INA, influential network agent; INL, influential network leader.

Seventy INAs did not achieve 1.5% success and were excluded from analyses as their invitation receipts were suspected to have been fraudulently completed. These INAs distributed 125 invitations/INA and were similar to INAs in the analysis by gender (χ^2 test of association=0.8, p=0.4), age (t-statistic=-1.9, p=0.06) and network ($\chi^2=3.7$, p=0.3). The average success of these 70 INAs was 0.57%, and when adding these INAs to those included in the analysis, the overall INA success was 4.97%.

Couple and invitation characteristics associated with couples' testing

The mean age of men was 33 years and of women was 27 years (table 3). The couples tested were slightly older than those not tested (p<0.001). Most couples were cohabiting, and these were significantly more likely to test versus non-cohabiting couples. The mean duration of a relationship was 6 years, and tested couples had been together on average 1 year longer than non-tested couples.

INAs initiated contact 93% of the time, although in the rare instances when the couple or the woman initiated contact with the INA, the couple was more likely to test. Inviting a couple together also resulted in increased testing. Couples who were family members or social acquaintances of the INA were more likely to test versus those previously unacquainted. Ease of invitation delivery (operationalised as not being time consuming, requiring long explanations, challenging because of invitee resistance or scheduling conflicts) was also associated with couples' testing. Interestingly, though public endorsements were predictive of testing during a pilot study,¹³ they were not associated with increased uptake of testing in this larger study. Similarly, the presence of mobile units was not associated with increased testing (table 3).

Multivariate model of couples' testing predictors

Age of the man and woman was collinear and woman's age was excluded from the multivariate model (table 4). Couple cohabitation status was an effect measure modifier, and multivariate analyses were stratified by cohabitation status. All adjusted ORs (aORs) presented below were statistically significant in multivariate analyses accounting for two-level clustering.

Health sector INAs were most successful (aOR=1.5) followed by CBO/NGO INAs (aOR=1.3) relative to private sector INAs. Married INAs were more successful versus others among cohabiting couples (aOR=1.3). Sales/service industry employees (aOR=1.5) versus unskilled manual labourers were more successful overall. Among non-cohabiting couples, INAs who could read English were more successful (aOR=2.0) whereas among cohabiting couples, INAs owning homes were less successful (aOR=0.7). INAs who had tested for HIV with a partner were more successful among all couples (aOR=1.4), while those who had tested for HIV alone were more successful among non-cohabiting couples (aOR=2.1), versus INAs who had never tested for HIV.

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

INA characteristics	All couples				Cohabiting couples				Non-cohabiting couples			
	OR	95% CI		P Value	OR	95% CI		P Value	OR	95% CI		P Value
Network												
Private	Ref				Ref				Ref			
CBOs/NGOs	1.23	1.06	1.43	0.01	1.21	1.03	1.42	0.02	1.35	0.88	2.06	0.17
Health	1.29	1.12	1.49	0.001	1.25	1.07	1.46	0.01	1.56	1.04	2.35	0.03
Religious	1.06	0.90	1.26	0.48	1.07	0.90	1.27	0.47	1.02	0.63	1.66	0.94
Gender												
Male	Ref				Ref				Ref			
Female	0.97	0.88	1.07	0.58	1.01	0.91	1.12	0.84	0.79	0.60	1.03	0.09
Age (per year increase)	1.01	1.00	1.01	0.07	1.01	1.00	1.01	0.002	0.98	0.96	0.99	0.001
Years living in Lusaka (per year increase)	1.01	1.00	1.01	<0.001	1.01	1.01	1.01	<0.001	1.00	0.99	1.01	0.80
Relationship status												
Other (divorced, widowed, single)	Ref				Ref				Ref			
Married	1.19	1.07	1.32	0.001	1.22	1.09	1.36	0.001	0.96	0.73	1.26	0.75
Years of relationship (per year increase)*	1.00	0.99	1.01	0.97	1.01	1.00	1.01	0.09	0.95	0.93	0.97	<0.001
Occupation												
Unskilled manual labour	Ref				Ref				Ref			
Professional	1.14	0.97	1.35	0.11	1.02	0.86	1.22	0.82	2.25	1.42	3.57	0.001
Sales/service	1.36	1.18	1.56	<0.001	1.31	1.13	1.52	<0.001	1.73	1.12	2.67	0.01
Agricultural	1.13	0.81	1.57	0.48	0.95	0.66	1.38	0.79	2.24	1.01	4.97	0.05
Do not work for money	0.99	0.83	1.18	0.92	0.99	0.82	1.18	0.87	1.09	0.63	1.88	0.76
Read English												
No	Ref				Ref				Ref			
Yes	1.14	1.00	1.30	0.05	1.06	0.92	1.21	0.44	2.12	1.35	3.33	0.001
Housing												
Other housing (rental, free)	Ref				Ref				Ref			
Own home	0.89	0.80	0.98	0.02	0.89	0.79	0.99	0.03	0.88	0.66	1.16	0.36
Ever tested for HIV												
No	Ref				Ref				Ref			
Yes with partner	1.39	1.21	1.59	<0.001	1.26	1.09	1.45	0.002	2.97	1.85	4.78	<0.001
Yes alone	1.22	1.06	1.41	0.01	1.13	0.97	1.31	0.11	2.42	1.48	3.95	<0.001

*Among those with a partner.

INA, influential network agent; INL, influential network leader.

Cohabiting couples were more likely to test (aOR=1.4) versus non-cohabiting couples.

Invitation-level predictors of testing among cohabiting couples included inviting the couple versus the woman/man alone (aOR=1.2); also couple (aOR=1.4) or woman (aOR=1.6) versus INA initiated contact was predictive. Being socially acquainted with the INA (aOR=1.6) versus having just met was predictive among all couples, while home CVCT invitation delivery (aOR=1.4) versus elsewhere, and easy invitation delivery (aOR=1.9) versus difficult were predictive among cohabiting couples.

DISCUSSION

In an African capital city where very few couples have jointly tested for HIV, a promotional programme using INLs and INAs prompted approximately 100 couples/month to seek CVCT. INA network, occupation, marital status and testing history, as well as couple cohabitation

status and the INA–invitee relationship influenced invitation success. Invitations delivered to the couple, in the home, and invitations initiated by the woman partner were also significant CVCT uptake predictors.

CBOs/NGOs and health network INAs were more successful than faith-based or private sector INAs. CBO/NGO networks included parent-teacher, legal aid, skills training and health information organisations. Health networks included clinical officers, nurses, home healthcare visitors, community health workers, neighbourhood health committee members and traditional birth attendants. The private sector included individuals who were self-employed or those involved in providing the public with goods or services. Previous studies have similarly demonstrated the ability of influential people to effectively disseminate information and change attitudes and behaviours towards HIV in sub-Saharan Africa.^{16–18} Unlike health and CBO/NGO INAs, private sector INAs may have been preoccupied with income

Table 3 Bivariate association between couple and invitation characteristics and couples' testing accounting for clustering within INAs and INLs

	All couples		Couples not tested		Couples tested		OR	95% CI		p Value
	N	%	N	%	N	%				
Couple characteristics										
Age of man (mean, SD)	33.25	9.03	33.16	8.99	34.61	9.43	1.01	1.01	1.02	<0.001
Age of woman (mean, SD)	27.12	7.75	27.03	7.72	28.60	8.15	1.02	1.02	1.03	<0.001
Relationship of couple										
Not cohabiting	5275	18	5058	19	217	13	Ref			
Cohabiting	23664	82	22161	81	1503	87	1.58	1.38	1.81	<0.001
Years of relationship (mean, SD)	6.27	6.42	6.22	6.35	7.18	7.38	1.02	1.01	1.03	<0.001
Number of children (mean, SD)	2.04	2.16	2.04	2.16	2.06	2.12	1.01	0.99	1.03	0.29
Invitation characteristics										
Invitee (1st contact)										
Woman	8934	31	8426	31	508	30	Ref			
Couple	8567	30	7972	29	595	35	1.24	1.08	1.43	0.002
Man	11467	40	10851	40	616	36	0.91	0.81	1.03	0.13
Who initiated contact?										
INA	26620	93	25103	93	1517	89	Ref			
Couple	527	2	475	2	52	3	1.71	1.34	2.18	<0.001
Man	877	3	811	3	66	4	1.18	0.88	1.58	0.26
Woman	690	2	624	2	66	4	1.59	1.20	2.10	0.001
Relationship to INA										
Just met/unknown	19688	68	18749	69	939	55	Ref			
Co-worker	287	1	269	1	18	1	1.35	0.89	2.06	0.16
Family	1697	6	1525	6	172	10	2.08	1.75	2.49	<0.001
Social acquaintance (neighbour, friend, church member)	7186	25	6601	24	585	34	1.64	1.43	1.87	<0.001
Place of invitation										
Community	9828	34	9339	35	489	29	Ref			
Couple home	15460	54	14532	54	928	55	1.41	1.23	1.61	<0.001
INA home	1636	6	1461	5	175	10	2.25	1.87	2.71	<0.001
Couple or INA work	1812	6	1702	6	110	6	1.21	0.97	1.51	0.09
Public endorsement										
No	18148	63	17080	63	1068	62	Ref			
Yes	10715	37	10066	37	649	38	1.04	0.92	1.17	0.53
Delivering invitation										
Difficult/somewhat difficult	3030	10	2912	65	118	0.4	Ref			
Easy	25860	89	1599	35	24261	99.5	1.60	1.33	1.93	<0.001
Mobile unit present at time of invitation										
No	14268	49	13713	50	909	53	Ref			
Yes	14622	51	13679	50	818	47	1.12	0.89	1.39	0.33
Neighbourhood of invitation										
Neighbourhood 1	13705	47	12911	47	794	46	Ref			
Neighbourhood 2	15414	53	14481	53	933	54	0.97	0.79	1.18	0.74

Community: church/mosque, clinic, market, street/public place, social gathering.
 INA, influential network agent; INL, influential network leader.

generation and/or did not have similar opportunities to integrate CVCT promotions into their daily routine. The marginal performance of faith-based INAs was surprising given Zambia is strongly religious; however, though religious leaders have opportunities to promote from the pulpit, the stigma associated with sexually transmitted infections (STIs) may inhibit open discussion on CVCT.^{17 25}

Cohabiting couples were more likely than non-cohabiting couples to test, and married INAs delivered more successful invitations than unmarried INAs. Fear

of stigma among married couples is common,^{9 26 27} and perhaps married INAs were able to more successfully overcome this barrier with their fellow married couples. INAs who previously tested for HIV with a partner were also more successful than those who had not tested, likely due to their first hand knowledge of CVCT procedures and ability to speak personally to perceived CVCT barriers.

INAs socially acquainted with the invitee were more successful versus those who were previously

Table 4 Multivariate model of INA-level, couple-level and invitation-level characteristics associated with couples' testing

	All couples				Cohabiting couples				Non-cohabiting couples			
	OR	95% CI	p Value		OR	95% CI	p Value		OR	95% CI	p Value	
INA characteristics												
Network												
Private	Ref				Ref				Ref			
Religious	1.01	0.71 1.43	0.95		1.01	0.73 1.40	0.94		1.16	0.49 2.77	0.74	
Health	1.53	1.15 2.04	0.004		1.48	1.11 1.97	0.01		1.80	0.96 3.35	0.07	
CBOs/NGOs	1.34	1.01 1.77	0.04		1.31	0.98 1.76	0.07		1.53	0.84 2.79	0.16	
Years living in Lusaka	1.01	1.00 1.02	0.14		1.01	1.00 1.02	0.07		1.01	0.99 1.04	0.24	
Age (per 1 year increase)	1.00	0.99 1.02	0.79		1.00	0.99 1.02	0.53		0.99	0.97 1.01	0.35	
Marital status												
Other (divorced, widowed, single)	Ref				Ref				Ref			
Married	1.23	0.99 1.53	0.06		1.28	1.02 1.60	0.03		1.06	0.70 1.62	0.77	
Occupation												
Unskilled manual labour	Ref				Ref				Ref			
Professional	1.19	0.77 1.84	0.45		1.06	0.69 1.64	0.79		1.98	0.92 4.27	0.08	
Sales/service	1.45	1.01 2.10	0.05		1.37	0.94 1.99	0.11		1.67	0.88 3.19	0.12	
Agricultural	1.14	0.65 2.01	0.64		0.97	0.55 1.72	0.93		1.68	0.60 4.67	0.32	
Do not work for money	0.95	0.62 1.45	0.81		0.95	0.62 1.45	0.80		0.69	0.26 1.82	0.45	
Reads English												
No	Ref				Ref				Ref			
Yes	1.18	0.90 1.55	0.22		1.15	0.87 1.51	0.32		1.98	1.05 3.72	0.03	
Housing												
Other housing (rental, free)	Ref				Ref				Ref			
Own home	0.74	0.59 0.92	0.01		0.73	0.58 0.91	0.01		0.93	0.62 1.38	0.71	
Ever tested for HIV												
No	Ref				Ref				Ref			
Yes with partner	1.36	1.07 1.72	0.01		1.29	1.01 1.66	0.04		2.13	1.27 3.57	0.004	
Yes alone	1.28	1.00 1.64	0.05		1.21	0.94 1.56	0.15		1.92	1.10 3.35	0.02	
Couple characteristics												
Age of man (per 1 year increase)	1.00	1.00 1.01	0.30		1.01	1.00 1.02	0.10		1.03	1.00 1.05	0.02	
Years of relationship (per 1 year increase)	1.01	0.99 1.02	0.35		1.02	1.01 1.03	<0.001		0.45	0.37 0.55	<0.001	
Relationship of couple												
Not cohabiting	Ref				n/a				n/a			
Cohabiting	1.39	1.19 1.63	<0.001									
Invitation characteristics												
Invitee (1st contact)												
Individual (woman/man)	Ref				Ref				Ref			
Couple	1.20	1.04 1.39	0.01		1.27	1.09 1.49	0.003		0.82	0.52 1.28	0.38	
Who initiated contact?												
INA	Ref				Ref				Ref			
Couple	1.35	1.03 1.78	0.03		1.43	1.05 1.94	0.02		0.94	0.27 3.20	0.92	
Man	1.22	0.89 1.67	0.22		1.26	0.90 1.75	0.18		1.00	0.47 2.12	1.00	
Woman	1.60	1.17 2.19	0.003		1.53	1.10 2.12	0.01		1.54	0.73 3.27	0.26	
Relationship to INA												
Just met/unknown	Ref				Ref				Ref			
Co-worker	1.48	0.89 2.43	0.13		1.47	0.84 2.55	0.18		1.11	0.27 4.56	0.89	
Social acquaintance (neighbour, friend, church member, family)	1.62	1.41 1.87	<0.001		1.60	1.37 1.87	<0.001		1.60	1.15 2.24	0.01	
Place of invitation												
Other (community or couple/INA work)	Ref				Ref				Ref			
Couple or INA home	1.30	1.14 1.48	<0.001		1.39	1.21 1.61	<0.001		0.93	0.68 1.27	0.65	
Delivering invitation												
Difficult/somewhat difficult	Ref				Ref				Ref			
Easy	1.75	1.41 2.17	<0.001		1.87	1.47 2.37	<0.001		1.15	0.67 1.99	0.61	
INA, influential network agent.												

unacquainted. The strength of INA–invitee relationship may facilitate open discussion on CVCT and engender confidence. INAs inviting the couple together versus either partner alone, potentially removing pressure for one partner to propose testing to the other, were also more successful. Previous studies support the effectiveness of couple-level-targeted prevention strategies.^{13 28–31}

Although most invitations were initiated by INAs, when the woman partner initiated contact with the INA, the CVCT uptake increased. This finding likely reflects pre-existing motivation to discuss or participate in CVCT.

Invitations delivered in the home versus community were more effective. Previous studies indicate that home and workplace HIV counselling and testing promotions are more successful in Zambia, Uganda and Malawi relative to community locations.^{32–35} These findings are likely due to increased discretion and comfort associated with home settings.

Results from a similar study using both INLs and INAs in Kigali, Rwanda highlight country-specific similarities and differences. Similar to Zambia, Rwandan health INAs were more successful relative to private network INAs. Married Rwandan INAs were more successful than single INAs, and cohabiting couples were more likely to test than non-cohabiting couples in univariate analyses. We similarly found that invitations delivered to couples socially acquainted with the INA, woman partner initiated contact and invitations delivered at home were more successful in multivariate analyses in Rwanda. In contrast to this study, Rwandan faith-based INAs were more successful in univariate analyses relative to private network INAs, and the overall INA success rate in Rwanda was higher (18%). Mobile units were also associated with increased testing in Rwanda.²⁰ We were surprised that the mobile unit was not predictive of testing in this analysis as in Rwanda, not because of mitigated transportation costs, which were reimbursed, but because of the increased convenience and decreased time commitments engendered by mobile testing. More research is needed to determine why the mobile testing units did not increase uptake.

Kigali and Lusaka, though both capital cities, differ in several important ways: Kigali has a monolingual population of 800 000 with easy and inexpensive transportation. In contrast, Lusaka's 1.7 million inhabitants represent all 73 Zambian languages/dialects, the city is large and transportation is expensive. Another study in the Bemba-speaking Copperbelt region of Zambia combined INA promotions with mass media strategies in two cities of 600 000 each and obtained success rates between those found in Lusaka and Kigali.¹⁴ These linguistic and infrastructural differences highlight the importance of testing and adapting network-based promotional models to different environments.

Results from a pilot study of promotions in Lusaka with 33 INAs (no INLs) showed that, while invitation-level predictors were similar to those found in this larger

study, the small sample size did not allow simultaneous detection of INA-level, couple-level and invitation-level characteristics in hierarchical analysis.¹³ Similarly, the Copperbelt study described previously did not examine INA-level, couple-level or invitation-level predictors of success.¹⁴

The exclusion of the 70 INAs who did not achieve 1.5% success was considered necessary in order to determine the INA-level predictors of successful invitation delivery among INAs not returning fraudulent invitation receipts. We acknowledge that this exclusion may discount INAs who were poor performers in addition to INAs returning fraudulent receipts thereby reducing the generalisability of our findings to more productive INAs.

Overall, this study demonstrated the feasibility of CVCT promotions in Lusaka, and we believe success rates could be considerably increased by utilising the modifiable predictors of CVCT uptake identified: recruiting INAs who have tested with partners, focusing invitations on INA acquaintances, issuing invitations to couples and in a discreet location and utilising INAs from CBOs/NGOs and health networks. It should be noted that most of the statistically significant aORs are close to the null, suggesting cautious interpretation of these associations. More research is especially needed to encourage faith-based leaders in Zambia to promote CVCT more effectively.

CONCLUSION

CVCT is an evidence-based testing strategy shown to reduce transmission of HIV and other STIs and to help prevent unintended pregnancies in sub-Saharan Africa. However, CVCT is yet to be widely implemented in this region.^{4 6 7 36–40} Here, we demonstrated not only the feasibility of CVCT promotions using INAs and INLs, but also identified practical INA-level, couple-level and invitation-level factors that were marginally though significantly predictive of CVCT uptake in these analyses. These predictors can be used to enhance CVCT promotions in Zambia and may be extended as a framework to other locales, with adaptation based on location-specific predictors of CVCT promotions.

Author affiliations

¹Department of Pathology & Laboratory Medicine, Rwanda Zambia HIV Research Group, School of Medicine, Atlanta, Georgia, USA

²Hubert Dept of Global Health, Rollins School of Public Health, Emory University, Atlanta, Georgia, USA

³Zambia Emory HIV Research Project, Lusaka, Zambia

⁴Department of Epidemiology, Rollins School of Public Health, Emory University, Atlanta, Georgia, USA

⁵Department of Biostatistics and Bioinformatics, Rollins School of Public Health, Emory University, Atlanta, Georgia, USA

⁶University Teaching Hospital and University of Zambia School of Medicine, Lusaka, Zambia

⁷Zambia National Blood Transfusion Services, Lusaka, Zambia

⁸College of Medicine, University of Illinois at Chicago, Chicago, Illinois, USA

Acknowledgements We would like to thank the Project Management Group, staff, and study participants of the Zambia-Emory HIV Research Project in Lusaka, Zambia. We would also like to thank Drs. Patrick Sullivan, David L. Roth, Leslie Clark, and Joseph Telfair and interns Steve Dunham and Helen Ji for their contributions.

Contributors KMW made substantial contributions to the analysis and interpretation of data, drafting the article and revising it critically for important intellectual content and gave final approval of the version to be published. WK made substantial contributions to study conception and design, revising the article critically for important intellectual content, and gave final approval of the version to be published. AN made substantial contributions to the analysis and interpretation of data, revising the article critically for important intellectual content, and gave final approval of the version to be published. CV made substantial contributions to study conception and design, revising the article critically for important intellectual content, and gave final approval of the version to be published. MK made substantial contributions to study conception and design, revising the article critically for important intellectual content, and gave final approval of the version to be published. EC made substantial contributions to study conception and design, revising the article critically for important intellectual content, and gave final approval of the version to be published. AT made substantial contributions to study conception and design, revising the article critically for important intellectual content, and gave final approval of the version to be published. GS made substantial contributions to study conception and design, revising the article critically for important intellectual content, and gave final approval of the version to be published. DC made substantial contributions to data acquisition, revising the article critically for important intellectual content, and gave final approval of the version to be published. FH made substantial contributions to data acquisition, revising the article critically for important intellectual content, and gave final approval of the version to be published. JM made substantial contributions to data acquisition, revising the article critically for important intellectual content, and gave final approval of the version to be published. DK made substantial contributions to the analysis and interpretation of data, revising the article critically for important intellectual content, and gave final approval of the version to be published. SA was the PI of the chief sponsoring grant NIMH 66767 and made substantial contributions to study conception and design, revising the article critically for important intellectual content, and gave final approval of the version to be published.

Funding This work was supported by funding from the National Institute of Mental Health (R01 66767); the AIDS International Training and Research Program Fogarty International Center (D43 TW001042); the Emory Center for AIDS Research (P30 AI050409); National Institutes of Health (R01s AI40951, AI51231, HD40125); International AIDS Vaccine Initiative. In addition, this publication has been supported by the President's Emergency Plan for AIDS Relief (PEPFAR) through the Centers for Disease Control and Prevention under the terms of Cooperative Agreement 3U2GPS001904-03. Its contents are solely the responsibility of the authors and do not necessarily represent official views of PEPFAR or the Centers for Disease Control and Prevention.

Competing interests None.

Patient consent Obtained.

Ethics approval The study was approved by the Emory University IRB and the University of Zambia Research Ethics committee.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement No additional data are available.

REFERENCES

1. Global Report: UNAIDS report on the global AIDS epidemic 2010. Joint United Nations Programme on HIV/AIDS (UNAIDS) 2010. http://www.unaids.org/documents/20101123_GlobalReport_em.pdf (accessed 19 Dec 2010).
2. Central Statistical Office (CSO), Ministry of Health (MOH), Tropical Diseases Research Centre (TDRC), University of Zambia, and Macro International Inc. *Zambia demographic and health survey 2007*. Calverton, MD, USA: CSO and Macro International Inc., 2009.
3. Dunkle KL, Stephenson R, Karita E, *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;371:2183–91.
4. Conkling M, Shutes EL, Karita E, *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;3:10.
5. UNAIDS Technical Update: Voluntary counselling and testing (VCT). Joint United Nations Programme on HIV/AIDS (UNAIDS) 2000. <http://www.who.org> (accessed 4 Dec 2010).
6. Allen S, Tice J, Van de Perre P, *et al*. Effect of serotesting with counselling on condom use and seroconversion among HIV discordant couples in Africa. *BMJ* 1992;304:1605–9.
7. The Voluntary HIV-1 Counseling and Testing Efficacy Study Group. Efficacy of voluntary HIV-1 counselling and testing in individuals and couples in Kenya, Tanzania, and Trinidad: a randomised trial. *Lancet* 2000;356:103–12.
8. Painter TM. Voluntary counseling and testing for couples: a high-leverage intervention for HIV/AIDS prevention in sub-Saharan Africa. *Soc Sci Med* 2001;53:1397–411.
9. Roth DL, Stewart KE, Clay OJ, *et al*. Sexual practices of HIV discordant and concordant couples in Rwanda: effects of a testing and counselling programme for men. *Int J STD AIDS* 2001;12:181–8.
10. Bakari JP, McKenna S, Myrick A, *et al*. Rapid voluntary testing and counseling for HIV. Acceptability and feasibility in Zambian antenatal care clinics. *Ann NY Acad Sci* 2000;918:64–76.
11. McKenna SL, Muyinda GK, Roth D, *et al*. Rapid HIV testing and counseling for voluntary testing centers in Africa. *AIDS* 1997;11 (Suppl 1):S103–10.
12. Chomba E, Allen S, Kanweka W, *et al*. Evolution of couples' voluntary counseling and testing for HIV in Lusaka, Zambia. *JAIDS* 2008;47:108–15.
13. Allen S, Karita E, Chomba E, *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.
14. Lambdin BH, Kanweka W, Inambao M, *et al*. Local residents trained as 'influence agents' most effective in persuading African couples on HIV counseling and testing. *Health Aff (Millwood)* 2011;30:1488–97.
15. Baiden F, Akanlu G, Hodgson A, *et al*. Using lay counsellors to promote community-based voluntary counselling and HIV testing in rural northern Ghana: a baseline survey on community acceptance and stigma. *J Biosoc Sci* 2007;39:721–33.
16. Helleringer S, Kohler HP. Social networks, perceptions of risk, and changing attitudes towards HIV/AIDS: new evidence from a longitudinal study using fixed-effects analysis. *Popul Stud (Camb)* 2005;59:265–82.
17. Trinitapoli J. Religious responses to AIDS in Sub-Saharan Africa: an examination of religious congregations in rural Malawi. *Rev Religious Res* 2006;47:253–70.
18. Kohler HP, Behrman JR, Watkins SC. Social networks and HIV/AIDS risk perceptions. *Demography* 2007;44:1–33.
19. Heaney CA, Israel BA. Social networks and social support. In: Glanz K, Rimer BK, Lewis FM, eds. *Health behavior and health education*. San Francisco, CA: Jossey-Bass, 2002.
20. Wall KM, Karita E, Nizam A, *et al*. Influence network effectiveness in promoting couples' HIV voluntary counseling and testing in Kigali, Rwanda. *AIDS* 2012;26:217–27.
21. Kelley A, Karita E, Sullivan P, *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: e19573.
22. Zambia GDP - per capita (PPP). IndexMundi 2011. [http://www.indexmundi.com/zambia/gdp_per_capita_\(ppp\).html](http://www.indexmundi.com/zambia/gdp_per_capita_(ppp).html) (accessed 29 Feb 2012).
23. Zambian Economy Statistics. NationMaster 2003–2012. http://www.nationmaster.com/graph/eco_pop_und_1_a_day-economy-population-under-1-day (accessed 29 Feb 2012).
24. Boeras DI, Luisi N, Karita E, *et al*. Indeterminate and discrepant rapid HIV test results in couples' HIV testing and counselling centres in Africa. *J Int AIDS Soc* 2011;14:18.
25. Ucheaga DN, Hartwig KA. Religious leaders' response to AIDS in Nigeria. *Glob Public Health* 2010;5:611–25.
26. Kilewo C, Massawe A, Lyamuya E, *et al*. HIV counseling and testing of pregnant women in sub-Saharan Africa: experiences from a study on prevention of mother-to-child HIV-1 transmission in Dar es Salaam, Tanzania. *JAIDS* 2001;28:458–62.
27. Keogh P, Allen S, Almedal C, *et al*. The social impact of HIV infection on women in Kigali, Rwanda: a prospective study. *Soc Sci Med* 1994;38:1047–53.

28. Kakimoto K, Kanal K, Mukoyama Y, *et al.* Influence of the involvement of partners in the mother class with voluntary confidential counseling and testing acceptance for prevention of mother to child transmission of HIV programme (PMTCT programme) in Cambodia. *AIDS Care* 2007;19:381–4.
29. Desgrees du Lou A, Brou H, Djohan G, *et al.* Beneficial effects of offering prenatal HIV counselling and testing on developing a HIV preventive attitude among couples, Abidjan 2002–2005. *AIDS Behav* 2009;13:348–55.
30. El-Bassel N, Witte SS, Gilbert L, *et al.* The efficacy of a relationship-based HIV/STD prevention program for heterosexual couples. *Am J Public Health* 2003;93:963–9.
31. Were WA, Mermin JH, Wamai N, *et al.* Undiagnosed HIV infection and couple HIV discordance among household members of HIV-infected people receiving antiretroviral therapy in Uganda. *JAIDS* 2006;43:91–5.
32. Angotti N, Gaydosh L, Kimchi E, *et al.* The fear factor in HIV testing: local reactions to door-to-door rapid blood testing for HIV in rural Malawi. American Sociological Association Annual Conference. New York, NY, 2007.
33. Fylkesnes K, Siziya S. A randomized trial on acceptability of voluntary HIV counselling and testing. *Trop Med Int Health* 2004;9:566–72.
34. Corbett E, Dauya E, Matambo R, *et al.* Uptake of workplace HIV counselling and testing: a clusterrandomised trial in Zimbabwe. *PLoS Med* 2006;3:e238.
35. Wolff B, Nyanzi B, Katongole G, *et al.* Evaluation of a home-based voluntary counselling and testing intervention in rural Uganda. *Health Policy Plan* 2005;20:109–16.
36. Allen S, Meizen-Derr J, Kautzman M, *et al.* Sexual behavior of HIV discordant couples after HIV counseling and testing. *AIDS* 2003;17:733–40.
37. King R, Allen S, Serufulira A, *et al.* Voluntary confidential HIV testing for couples in Kigali, Rwanda. *AIDS* 1993;7:1393–4.
38. Carpenter LM, Kamali A, Ruberantwari A, *et al.* Rates of HIV-1 transmission within marriage in rural Uganda in relation to the HIV sero-status of the partners. *AIDS* 1999;13:1083–9.
39. Fideli US, Allen SA, Musonda R, *et al.* Virologic and immunologic determinants of heterosexual transmission of human immunodeficiency virus type 1 in Africa. *AIDS Res Hum Retroviruses* 2001;17:901–10.
40. Allen S, Serufulira A, Gruber V, *et al.* Pregnancy and contraception use among urban Rwandan women after HIV testing and counseling. *Am J Public Health* 1993;83:705–10.