Published in final edited form as:

Soc Sci Med. 2013 November ; 96: 154–164. doi:10.1016/j.socscimed.2013.07.006.

Effects of an HIV peer prevention intervention on sexual and injecting risk behaviors among injecting drug users and their risk partners in Thai Nguyen, Vietnam: A randomized controlled trial

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Abstract

Globally, 30% of new HIV infections outside sub-Saharan Africa involve injecting drug users (IDU) and in many countries, including Vietnam, HIV epidemics are concentrated among IDU. We conducted a randomized controlled trial in Thai Nguyen, Vietnam, to evaluate whether a peer oriented behavioral intervention could reduce injecting and sexual HIV risk behaviors among IDU and their network members. 419 HIV-negative index IDU aged 18 years or older and 516 injecting and sexual network members were enrolled. Each index participant was randomly assigned to receive a series of six small group peer educator-training sessions and three booster sessions in addition to HIV testing and counseling (HTC) (intervention; $n = 210$) or HTC only (control; $n = 209$). Follow-up, including HTC, was conducted at 3, 6, 9 and 12 months post-intervention. The proportion of unprotected sex dropped significantly from 49% to 27% (SE (difference) = 3%, $p < 0.01$) between baseline and the 3-month visit among all index-network member pairs. However, at 12 months, post-intervention, intervention participants had a 14% greater decline in unprotected sex relative to control participants (Wald test = 10.8, $df = 4$, $p = 0.03$). This intervention effect is explained by trial participants assigned to the control arm who missed at least one standardized HTC session during follow-up and subsequently reported increased unprotected sex. The proportion of observed needle/syringe sharing dropped significantly between baseline and the 3-month visit (14% vs. 3%, SE (difference) = 2%, $p < 0.01$) and persisted until 12 months, but there was no difference across trial arms (Wald test = 3.74, $df = 3$, $p = 0.44$).

Keywords

Vietnam; Injecting drug use; HIV; Randomized controlled trial; Peer network; Intervention; Evaluation

Introduction

Thirty percent of new global HIV infections outside sub-Saharan Africa involve injecting drug users (IDU) (UNAIDS, 2006) and in many countries in eastern Europe, and central, south and southeast Asia, the majority of new HIV infections occur among IDU. Overall, an estimated 16% of people who inject drugs in Asia are living with HIV (Mathers et al., 2008), but HIV prevalence among IDU is much higher in areas within Thailand (24%) (Yongvanitjit et al., 2010), Indonesia (50%) (National AIDS Commission of Indonesia, 2008), and Vietnam (58%) (Ministry of Health of Vietnam, 2005; Quan et al., 2011; Tran et al., 2006).

HIV related sexual and injecting risks persist among IDU. IDU report low rates of condom use (Choi, Cheung, & Chen, 2006; Commission on AIDS in Asia, 2008; National Institute of Hygiene and Epidemiology, 2006; Yu et al., 2006). The consequences of this risk behavior are being seen in Vietnam, where, in a sample of sexual partners of IDU in Hanoi, 14% tested HIV-positive (Hammett, Van, Kling, Binh, & Oanh, 2010). In Vietnam, a significant proportion of IDU also report that they share injecting equipment despite wide availability of inexpensive needles and syringes (Quan et al., 2009). Appreciating and addressing the social context in which IDU engage in risk behavior is a critical element of effective HIV prevention.

Among IDU, social networks are a central component of the risk environment (De, Cox, Boivin, Platt, & Jolly, 2007; Latkin et al., 2011). Social networks and the strong ties that exist within them can have both negative and positive influences on an individual's behavior, and have been employed as a means of delivering HIV prevention messages (Dickson-Gomez, Weeks, Martinez, & Convey, 2006; Latkin et al., 2009; Latkin, Sherman, & Knowlton, 2003; Medley, Kennedy, O'Reilly, & Sweat, 2009; Tobin, Kuramoto, Davey-Rothwell, & Latkin, 2011). Social identity theory (Turner, 1975), and theories of the diffusion of innovations (Rogers, 2003), social influence (Lewis, DeVellis, & Sleath, 2002) and social norms (van Knippenberg, 2000) suggest that changing group or network norms may lead to a reduction in risk behaviors. These models posit that when new norms are introduced and adopted, groups reward members who comply, reinforcing the maintenance of new norms. There is evidence that a network-based approach to delivery of HIV prevention measures impacts self-reported risk behaviors among IDU in a variety of settings (Des Jarlais et al., 1995). In addition to network-based approaches, peer education has been used successfully in HIV prevention interventions among adolescents (Brieger, Delano, Lane, Oladepo, & Oyediran, 2001; Siegel, Aten, & Enaharo, 2001) and IDU (Garfein et al., 2007; Latkin et al., 2003; Sherman et al., 2009).

In northern Vietnam, where formative research has shown that the social networks of IDU are generally small (2–3 injectors) and influential, we hypothesized that IDU, trained as peer health educators, could facilitate HIV risk reduction within their social networks through normative influence (Kincaid, 2004). Further, we expected that peer health educators would reduce their own personal risk through the process of advocating risk reduction to peers (Latkin et al., 2003).

We conducted a randomized controlled trial (RCT) in Thai Nguyen, Vietnam, to assess whether a network-based peer education intervention with HIV testing and counseling (HTC), following national guidelines that adhere to CDC's Project Respect model (Ministry of Health of Vietnam, 2007), would reduce injecting and sexual risk behaviors compared to HTC alone among IDU living in northern Vietnam and their risk network members.

Methods

Study site

Substance abuse has been a growing public health problem in Vietnam since the mid-1990s. Between 2000 and 2004, the economy significantly improved following the expansion of market-oriented policies. The economic improvement allowed for increased access to services and commodities, including drugs. At the same time, Vietnam became an important drug transit route for heroin produced in the Golden Triangle. The transition increased heroin availability at low cost and encouraged new populations of drug users (Beyrer et al., 2000). As a result, there was a rapid increase in the number of drug users in Vietnam, followed by multiple outbreaks of HIV infections in various regions of the country (Quan, Chung, Long, & Dondero, 2000; Quan, Hien, & Go, 2008). The reported number of drug users in the country increased 70% from 101,000 to 170,000 between 2000 and 2004 (United Nations Office on Drugs and Crime, 2005).

The site of this study was the northern province of Thai Nguyen in Vietnam. Thai Nguyen has a population of approximately 1,100,000, an estimated population of 6400 IDU and an increasing burden of HIV (Thai Nguyen AIDS Center, 2011).

Recruitment

Eligibility criteria

The trial enrolled networks of IDU between 2005 and 2007. Index participants were identified through recruiters, who were typically current or former drug users. Recruiters approached IDU at venues in the community and interested individuals were referred to the study site. Each network was comprised of an index participant and at least one injecting or sexual partner that the participant identified and recruited. Eligibility criteria for index participants included: 1) being 18 years of age or older; 2) having injected at least once a week in the past 3 months; 3) having HIV negative antibody test results within 30 days prior to randomization; and 4) willingness to identify and recruit at least one HIV network member who was eligible for the study. We only included males as indexes since 97% of IDU are male in Thai Nguyen, and female IDU in Vietnam have a different risk context requiring a different type of intervention. Eligibility criteria for network members were: 1) being 18 years of age or older; 2) having injected drugs with or had sexual intercourse with the index participant in the past 3 months; and 3) interacting at least once a week with the index. Network members were not required to be HIV-negative.

Randomization and follow-up

The intervention was optimized for small group sessions with 12 index members, so we recruited 24 networks at a time. We randomized the networks to either the intervention or control arm, and then initiated the intervention or control condition as assigned. This process was repeated in groups of 24 networks until we reached the desired sample size. Index participants, whose networks were assigned to the intervention arm, attended weekly intervention sessions over a 6-week period. Network members of index participants assigned to the intervention arm did not receive direct intervention sessions, but instead, by design, received the intervention through their network index. Networks assigned to the control arm received standard of care HTC and government-sponsored pamphlets on HIV.

All participants were followed-up at 3-month intervals for 12 months. At baseline and in each follow-up visit, participants were tested for HIV antibody, counseled and administered a face-to-face interview using a structured questionnaire. We used HIV enzyme-linked immunosorbent assay (EIA) (Abbot Murex Biotech Ltd, Kent, England) to conduct HIV

antibody testing on serum specimens. We repeated a second EIA Genscreen HIV 1/2 (BioRad Laboratories, Marnes-la-Coquette, France) on reactive specimens, and confirmed them by Western blot analysis (BioRad). All participants were provided with pre-test and post-test HIV and sexually transmitted diseases counseling and appropriate referrals. The study was approved by ethics boards at Johns Hopkins University and Thai Nguyen Center for Preventive Medicine.

Intervention

The experimental intervention consisted of six 2-h, small group, peer educator training sessions during a six-week period and three booster sessions at three, six and nine months delivered to index participants. The intervention is modeled on Self-Help in Eliminating Life-threatening Diseases (SHIELD), a peer network-oriented intervention that successfully reduced injecting and sexual behaviors among IDU in Baltimore (Latkin et al., 2003). It draws on theories of social influence (Lewis et al., 2002), diffusion of innovations (Rogers, 2003), social learning (Bandura, 1977), social identity (Turner, 1975) and social norms (van Knippenberg, 2000). The intervention was adapted to the socio-cultural context of Thai Nguyen, based on results from our one-year qualitative and quantitative formative study (Go, Frangakis, et al., 2006; Go, Quan, et al., 2006; Quan et al., 2009; Schumacher et al., 2009). For example, in Thai Nguyen, needles are relatively cheap and easy to access, so purchasing multiple needles and syringes was encouraged vs. cleaning with bleach, which is not readily available in Thai Nguyen. In addition, sexual partners are relatively stable among IDU in Thai Nguyen, but communication about HIV risk is virtually non-existent, so the intervention facilitated the development of communication strategies about condom use. Intervention sessions provided instructions in harm reduction strategies and communication skills through techniques such as interactive role-plays, problem solving exercises, goal setting, and sharing of peer outreach experiences.

Independent quality assurance/quality control (QA/QC) staff from Hanoi attended twenty percent of the intervention sessions, and rated the session on fidelity to the intervention manual and the facilitator on the quality of instruction (Supplementary material). Ninety percent of the intervention sessions selected for QA/QC monitoring received a score of 8 out of 10 in categories including adherence to protocol, knowledge of subject, and ability to communicate the material effectively. Hanoi staff met with facilitators weekly to provide feedback on monitored sessions.

The main outcomes of the study were injecting and sexual risk behaviors. Mediating variables included number of index-initiated conversations about HIV risk with network members. Specifically, we hypothesized that the number of times index participants initiated conversations about HIV risk behaviors with their network members would be associated with the injecting and sex behavior of both the index and their networks.

Measures

Surveys were administered through face-to-face interviews by trained interviewers and included self reports on the following risk behaviors: injecting drug use, sharing injecting equipment (needles, syringes, cookers, cotton and rinse water, front and back loading), properly disinfecting injecting equipment, number of sex partners, condom use during vaginal and anal sex with primary and casual partners and HIV prevention conversations. We initially used drug use and sexual behavior measures that predict HIV status to create two scores at baseline. However, we found that the performance of the injecting and sexual risk scores was lower in terms of predicting HIV status than using the single variables “used others’ needle/syringe in past 3 months” and “having unprotected sex in the past 3 months.”

Therefore, we used these two variables as our main outcome variables to evaluate the intervention.

Analyses

Risk behavior outcomes were correlated both over time within an individual as well as among individuals from the same network. For each of the primary outcomes (needle/syringe sharing and any unprotected sex), we conducted two analyses, one based only on the index participant, and a second based on the network members. For each of these analyses, differences between intervention and control were obtained for each visit by intention to treat. The hypothesis of whether or not there was a difference in any of the four visits after baseline was assessed with the Wald test on 4 degrees of freedom that was obtained from the multivariate distribution of the estimators of differences for the four post-baseline visits.

In order to conduct the above analyses, first we addressed missing data at different visits by using the method of multiple imputation (Rubin, 1987). We implemented multiple imputation by developing a chain of prediction models for each visit based on all the other visits, which was fitted and used for imputation cyclically (details are described in Azur, Stuart, Frangakis, & Leaf, 2011). Such an approach is considered superior to alternatives for addressing missing data of outcomes in randomized trials (Ball et al., 2002; King et al., 1994; Little et al., 2012) because it (i) reduces bias through using existing information to predict the missing values; (ii) allows relatively low model dependence, since the imputation model is used only to predict the missing values and not for inferential purposes; and (iii) expresses uncertainty accurately, through the multiplicity of imputations. For the primary outcomes, the results based on multiple imputations were also juxtaposed to the results based on available cases analyses. Secondary analyses were also conducted in order to explain the findings of the primary analyses.

Results

Enrollment, adherence and retention

We enrolled 424 networks (419 indexes). Seventy-six of the 417 indexes analyzed had more than one network member. A total of 935 participants took part in the study and 915 of these index and network members were injectors at baseline. Of 1434 participants screened, 499 (34%) were deemed ineligible (Fig. 1) for the following primary reasons: both index and network members were HIV-positive (34%); the index did not bring in a network member (25%); the index provided an incorrect address (25%). Ineligible individuals were not statistically different from eligible individuals in socio-demographic characteristics, sexual risk behaviors or direct sharing of needles/syringes. Ineligible individuals were significantly more likely to share injecting equipment than eligible individuals (76% vs. 69%, $p = 0.01$). We excluded 7 incomplete network groups (comprising 11 participants) from the analysis, yielding a total of 417 networks. The overall retention rate (% who attended at least one follow-up visit) was 85% ($n = 357$) for the 419 index participants and 77% ($n = 398$) for the 516 network participants. Among 210 intervention index participants, 166 (79%) attended at least one intervention session, 155 (74%) attended at least four sessions, 124 (60%) attended all six sessions, 124 (60%) attended an optional session with a support person (Person Important to Me or PIM) and 63 (30%) attended all three optional booster sessions. The retention rates at 6 months were 69% for indexes and 61% for networks. Among those who dropped out, the main reasons included incarceration (30%) and moving out of the province (35%).

Baseline demographics and behaviors

Baseline demographics and injecting and sex behaviors are shown by arm in Table 1. The mean and median age of all participants was 32.0 and 31.8 years, respectively (range 17.6–59.4). The vast majority of participants lived in Thai Nguyen city, were male and of Kinh ethnicity (ethnic Vietnamese). More than half were working full-time. There were no significant differences between arms with respect to any demographic or risk characteristics. The baseline prevalence of HIV among network members was 41.9%.

Effect on behavior change mediators

At the final visit (12-month visit), indexes in the intervention arm were significantly more likely to report having initiated conversations about HIV/AIDS in the past 3 months than indexes in the control arm (50% in the intervention group and 36% in the control group, $p = 0.04$).

Intervention effect

There were 9 HIV seroconversions in the intervention arm and 6 in the control arm, among indexes. There was no significant difference in seroconversions between intervention and control arms over a 12-month period (logrank test over follow-up = 0.6, $p = 0.43$, Table 2).

The proportion of observed needle/syringe sharing dropped significantly between baseline and the 3-month visit among all indexes (14%–3%, SE (difference) = 2%, $p < 0.01$). This decrease persisted throughout all four visits. Considering all post-baseline visits, there was no difference between treatment arms at the 12-month visit (Wald test $W = 3.74$, $df = 3$, $p = 0.44$, Table 3).

Similarly, among networks (Fig. 2), there was a drop in injecting risk from baseline to the 3-month visit (13%–3% in control; 18%–3% in intervention) that was maintained for the remaining visits with no significant difference between arms, overall ($W = 5.95$, $p = 0.20$).

Decreases in unprotected sex in the past 3 months from baseline to the 3-month follow-up were also observed. However, there was a significant difference between treatment arms for both indexes and networks ($W = 10.8$, $df = 4$, $p = 0.03$, Table 4; $W = 12.2$, $df = 4$, $p = 0.02$, Fig. 3) at 12 months, driven by an increase in self-reported sexual risk in the control group. Those who increased the initiation of HIV conversations between baseline and 12-month visits did not have a larger drop in unprotected sex than those who did not initiate HIV conversations with network members at both baseline and the 12-month visit, suggesting that increasing the rate of HIV discussion is not a necessary pathway for having a large drop in unprotected sex.

There was no difference in needle/syringe sharing between intervention and control networks by number of main sessions attended, by session with support person attended, or by number of booster sessions attended. Those who attended booster sessions and those who attended support person sessions were more likely to decrease sexual risk behavior, controlling for baseline risk, although this did not achieve statistical significance. Interestingly, we also found that those who were at higher sexual risk at baseline were more likely to attend all six main sessions, the support person session and all three booster sessions (data not shown).

In order to understand the initial reduction in unprotected sex at the 3-month visit that was later reversed in the control arm and the unexpected reduction in needle/syringe sharing at the 3-month visit that was sustained throughout the trial in both study arms, we conducted secondary analyses to explore: 1) if the observed data themselves reflect the intended

measurements; and 2) if the above reversal was related to missing intermittent assessment visits. Specifically, we conducted secondary analyses to assess the potential role of secular trends, social desirability bias, contamination, telescoping and missing HTC sessions, which was part of the assessment visit in both arms.

Trends over time

In order to assess the possibility of secular (time-dependent) trends, we compared outcomes over time between those who enrolled at the start of the enrollment period to those who enrolled one year later. Table 5 shows that there was no difference in the outcomes by time of enrollment. Although we did not find evidence of a secular trend, the percent of participants who missed final assessment visits was higher among those entering the trial later in the study compared to those who entered at the beginning.

Social desirability

To assess the extent to which social desirability may have led participants to under-report risk behaviors, we conducted a sub-analysis among individuals who sero-converted during the trial. If social desirability were a major factor, we would expect that those who sero-converted would under-report injecting and sex risk behavior prior to sero-conversion. However, the vast majority (27 out of 29) of sero-converters (indexes and controls) reported high-risk behaviors. This relatively small sample of seroconverters provides no evidence that social desirability has a major role in masking reporting of risk behaviors.

Contamination

Contamination could have reduced differences in this social network trial, if participants in the intervention arm engaged in SHIELD messaging with participants in the control arm. Evaluation of discussions of HIV prevention among the control arm, however, did not reveal an increase in discussions over time.

Telescoping

Respondents often are asked in surveys to retrospectively report when something occurred, how long something lasted, or how often something happened within a certain time period. At this stage of the response process, dates or events can be erroneously reported forward (“telescoped”) in time.

In Table 6, we assessed if backward telescoping may have occurred, thereby inflating the number who shared needles/syringes or had unprotected sex at baseline and overestimating the difference in outcomes between baseline and the 3-month follow-up. To do this, we looked at individuals who had a non-monotone pattern in attended visits, and, more specifically, at those who had (a) at least two post-baseline visits, for example visits at times t1 and t2, and (b) missed all visits between t1 and t2. Table 6 highlights the patterns with criteria (a) and (b), and the visits t1 and t2 within each such pattern. If there was telescoping of risk behaviors, one would expect that some of the behaviors that occurred around the missed visit(s) between t1 and t2 would be telescoped to t2, which would then give consistently higher risk at t2 vs. t1. As can be seen in Table 6, there are five participants with higher risk at t2 than t1, but there are twice as many participants with the opposite trend, suggesting no evidence for telescoping.

HIV testing and counseling

To assess the possible impact of missed assessment visits and therefore missed HTC sessions, we explored the pattern of missed assessment visits and percent of indexes who had unprotected sex in the past 3 months. Among participants who attended all 5 assessment

visits, there was no difference between trial arms (Table 7). However, we found that among trial participants who had baseline and 12-month assessment visits but missed some in-between visits, control subjects were significantly more likely to report unprotected sex at 12 months compared to intervention subjects (20/34 vs. 6/27, $p < 0.01$), thereby accounting for the difference in the intervention effect. This difference remained significant after stratifying by reported risk at baseline: the difference was found for participants who had not reported risk at baseline (8/14 vs. 2/15, $p = 0.02$), but not for participants who had reported some risk at baseline (12/20 vs. 4/12, $p = 0.27$).

Discussion

Our study evaluated the outcomes of a community-based behavioral intervention trial where study conditions cannot be tightly controlled and outcomes may be susceptible to attrition, self-reporting bias, secular trends, historic factors and contamination.

This network-oriented intervention was well attended by participants and the intervention group was significantly more likely to initiate HIV conversations as compared to the control group (50% vs. 36%). The proportion initiating conversations was relatively high in both groups, perhaps due to an effect of being enrolled in an HIV study. Both intervention and control groups dramatically decreased injecting and sex risk behaviors after enrollment in the study with indexes and networks showing similar trends. Other randomized controlled trials of HIV risk reduction behavioral interventions among IDU (Latkin et al., 2003; Purcell et al., 2007), and the general population (NIMH Collaborative HIV/STD Prevention Trial Group, 2010) have observed decreases in risk behaviors or disease outcomes across both arms. The intensity of the comparison condition or assessment visits themselves have been cited as a possible explanation for RCTs that do not show a greater reduction of behavioral risk and disease incidence in the intervention relative to the comparison condition (NIMH Collaborative HIV/STD Prevention Trial Group, 2010; van Empelen et al., 2003). In our study, the control arm received the standard of care in Vietnam, namely, HIV education pamphlets that are currently available to IDU populations. In addition, as part of the assessment visits, both arms received HIV Testing and Counseling.

Regression toward the mean, selection bias, social desirability bias, secular trends, impact of being in a trial (e.g., regular HTC), contamination, and telescoping are all possible explanations for a reduction in levels of risk from baseline. Further analyses did not find evidence of selection bias, social desirability bias or secular trends. Our study suggests that the impact of simply being in a trial and/or participating in HTC may have had an effect on injecting behaviors up to 12 months and that both conditions may have had a comparable impact on reducing injecting risk behaviors. In Vietnam, considerable HIV injecting risk reduction messaging by the government and other international organizations may have primed IDU to change their injecting behavior. The relatively easy access to cheap needles (at local pharmacies) that exists in Vietnam, may further support behavior change in injecting practices. In Thai Nguyen and similar settings, providing access to HIV testing and/or facilitating membership in a group may be sufficient to encourage meaningful risk reduction, in the short term, among IDU who have access to clean syringes. Future interventions then may shift attention to structural factors, such as targeting potential harassment for carrying syringes and/or reducing IDU stigma, that may be needed to support sustainable reductions in HIV risk.

While unprotected sex declined in both arms at the 3-month visit, it increased at the 12-month visit among the control arm. Secondary analysis revealed that this difference is accounted for by participants who missed assessment visits between baseline and 12-month follow-up. Among this group of participants who missed assessment visits, individuals in

the control group experienced a significant increase in the proportion reporting unprotected sex while individuals' risk in the intervention group did not increase. Previous studies have shown that reductions in sexual risk among IDU can be challenging to achieve through behavioral interventions (Copenhaver, Johnson, Lee, Harman, & Carey, 2006; Mausbach, Semple, Strathdee, Zians, & Patterson, 2007; van Empelen et al., 2003). However, similar to our intervention, some interventions have led to moderate sexual risk reduction among drug users with the strongest effects in studies with comparison groups that received no intervention vs. comparison groups that received a standard or education intervention (Meader et al., 2013; Semaan et al., 2002). A recent study in Vietnam found that an intervention to increase condom use among primary sexual partners of IDU through peer district coordinators was effective in increasing condom use at last sex, but not in increasing consistent condom use; and that many primary sexual partners remain at high risk for HIV (Hammett et al., 2012). Studies have suggested that condoms are less likely to be used in primary compared with casual relationships (Kapadia et al., 2007; Sherman & Latkin, 2001). Condom use may infer a level of mistrust between partners, which can interfere with the desire to have a long-term relationship. In our study, among those who had unprotected sex at the 12-month follow-up, over 88% was with primary partners. The high proportion of sex with primary partners may explain the relatively modest effect our intervention had on condom use.

In Vietnam, while there have been substantial HIV prevention messages focusing on injecting risk behaviors, there is minimal media exposure on HIV and sexual behaviors among the general population, and in particular among IDU. Our findings suggest that a more intensive, peer-based intervention such as ours may be needed to develop effective communication strategies and ultimately increase condom use among couples where one primary partner injects drugs.

The study had several limitations. By study design, an individual could only participate as either an index or network member once. In addition, formative research informed us that network sizes were small (2–3 persons) and isolated. However, there may have been overlap among networks, resulting in contamination and risk reduction in the control group. Future network studies should measure overlap among networks and utilize selection and training methods to reduce overlaps and contamination, for example through geographic distance. In addition, the sample was not randomly selected, which limits the generalizability of the findings. While our sample reflects the demographic profile of IDU in Thai Nguyen, additional studies are needed to determine whether the peer educator network-oriented intervention would be effective in other settings. Despite having research staff contact and remind participants about follow-up visits, the overall retention rate was only 85%; and at 6 months, 61%. This reflects the challenges in working with populations who are both mobile and susceptible to incarceration and death.

Network participants' results mirror those of the indexes, suggesting that the intervention was successful in reaching not only indexes but their network members as well. In the context of Vietnam, drug users are a highly stigmatized, impoverished, and marginalized group. Our study suggests that even under these conditions, peer educators may be able to effectively promote behavior change among their social network members. Most peer education interventions for IDU have focused on drug use as compared to sexual risk behaviors (Semaan, Neumann, Hutchins, D'Anna, & Kamb, 2010); however, our study and others suggest that reducing sexual risk in this population is possible (Meader et al., 2013; Semaan et al., 2002).

This study also highlights the potential efficacy of the comparison condition (HTC), especially among individuals exposed to long-term media campaigns. In settings where HIV

prevention media campaigns are widespread, HTC may be sufficient to reduce injecting risks; however, intensive, short, face-to-face interventions, such as our peer network-oriented intervention, may be an effective approach to reduce sexual risks among persons who inject drugs. At the same time, the study results, which showed that participants in both arms continued to inject at a high level, underscore the need to improve access to effective drug treatments such as opioid substitution therapy.

In conclusion, in our trial assessing the effectiveness of a 6-session intervention to decrease HIV risk behaviors among IDU and their risk networks, injecting risk behavior decreased significantly in both intervention and control arms at the 3-month follow-up and this decrease was sustained at the 12-month follow-up. However, while sexual risk behavior decreased significantly in both arms at the 3-month follow-up, at 12 months post intervention, participants had a 14% greater decline in unprotected sex compared to control participants. Further analysis suggested that the intervention effect is explained by trial participants assigned to the control arm who missed at least one standardized HIV testing and control session post intervention and subsequently reported an increase in unprotected sex. This suggests that the intervention may have had a moderate effect on sexual risk behaviors among index-network member pairs compared to standard HIV testing and counseling offered in both arms.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This study was supported by grant no. 1RO1 MH64895 from the National Institute of Mental Health (NIMH), National Institutes of Health, USA.

References

- Azur MJ, Stuart EA, Frangakis C, Leaf PJ. Multiple imputation by chained equations: what is it and how does it work? *International Journal of Methods in Psychiatric Research*. 2011; 20:40–49. [PubMed: 21499542]
- Ball K, Berch DB, Helmers KF, Jobe JB, Leveck MD, Marsiske M, et al. Effects of cognitive training interventions with older adults: a randomized controlled trial. *Journal of the American Medical Association*. 2002; 288:2271–2281. [PubMed: 12425704]
- Bandura, A. *Social learning theory*. Englewood Cliffs, NJ: Prentice Hall; 1977.
- Beyrer C, Razak MH, Lisam K, Chen J, Lui W, Yu XF. Overland heroin trafficking routes and HIV-1 spread in south and south-east Asia. *AIDS*. 2000; 14:75–83. [PubMed: 10714570]
- Brieger WR, Delano GE, Lane CG, Oladepo O, Oyediran KA. West African youth initiative: outcome of a reproductive health education program. *Journal of Adolescent Health*. 2001; 29:436–446. [PubMed: 11728893]
- Choi SY, Cheung YW, Chen K. Gender and HIV risk behavior among intravenous drug users in Sichuan province, China. *Social Science & Medicine*. 2006; 62:1672–1684. [PubMed: 16185801]
- Commission on AIDS in Asia. *Redefining AIDS in Asia: Crafting an effective response*. New Delhi: Oxford University Press; 2008. http://data.unaids.org/pub/Report/2008/20080326_report_commission_aids_en.pdf [Accessed 25.05.12]
- Copenhaver MM, Johnson BT, Lee IC, Harman JJ, Carey MP. Behavioral HIV risk reduction among people who inject drugs: meta-analytic evidence of efficacy. *Journal of Substance Abuse Treatment*. 2006; 31:163–171. [PubMed: 16919744]
- De P, Cox J, Boivin JF, Platt RW, Jolly AM. The importance of social networks in their association to drug equipment sharing among injection drug users: a review. *Addiction*. 2007; 102:1730–1739. [PubMed: 17935581]

- Des Jarlais DC, Friedman SR, Friedmann P, Wenston J, Sotheran JL, Choopanya K, et al. HIV/AIDS-related behavior change among injecting drug users in different national settings. *AIDS*. 1995; 9:611–617. [PubMed: 7662201]
- Dickson-Gomez J, Weeks M, Martinez M, Convey M. Times and places: process evaluation of a peer-led HIV prevention intervention. *Substance Use and Misuse*. 2006; 41:669–690. [PubMed: 16603454]
- van Empelen P, Kok G, van Kesteren NM, van den Borne B, Bos AE, Schaalma HP. Effective methods to change sex-risk among drug users: a review of psychosocial interventions. *Social Science & Medicine*. 2003; 57:1593–1608. [PubMed: 12948569]
- Garfein RS, Golub ET, Greenberg AE, Hagan H, Hanson DL, Hudson SM, et al. A peer-education intervention to reduce injection risk behaviors for HIV and hepatitis C virus infection in young injection drug users. *AIDS*. 2007; 21:1923–1932. [PubMed: 17721100]
- Go VF, Frangakis C, Nam le V, Bergenstrom A, Sripaipan T, Zenilman JM, et al. High HIV sexual risk behaviors and sexually transmitted disease prevalence among injection drug users in Northern Vietnam: implications for a generalized HIV epidemic. *Journal of Acquired Immune Deficiency Syndromes*. 2006a; 42:108–115. [PubMed: 16763499]
- Go VF, Quan VM, Voytek C, Celentano D, Nam le V. Intra-couple communication dynamics of HIV risk behavior among injecting drug users and their sexual partners in Northern Vietnam. *Drug and Alcohol Dependence*. 2006b; 84:69–76. [PubMed: 16413145]
- Hammett TM, Kling R, Van NT, Son DH, Binh KT, Oanh KT. HIV prevention interventions for female sexual partners of injection drug users in Hanoi, Vietnam: 24-month evaluation results. *AIDS and Behavior*. 2012; 16:1164–1172. [PubMed: 22016330]
- Hammett TM, Van NT, Kling R, Binh KT, Oanh KT. Female sexual partners of injection drug users in Vietnam: an at-risk population in urgent need of HIV prevention services. *AIDS Care*. 2010; 22:1466–1472. [PubMed: 21154034]
- Kapadia F, Latka MH, Hudson SM, Golub ET, Campbell JV, Bailey S, et al. Correlates of consistent condom use with main partners by partnership patterns among young adult male injection drug users from five US cities. *Drug and Alcohol Dependence*. 2007; 91(Suppl 1):S56–S63. [PubMed: 17329041]
- Kincaid DL. From innovation to social norm: bounded normative influence. *Journal of Health Communication*. 2004; 9(Suppl 1):37–57. [PubMed: 14960403]
- King SB 3rd, Lembo NJ, Weintraub WS, Kosinski AS, Barnhart HX, Kutner MH, et al. A randomized trial comparing coronary angioplasty with coronary bypass surgery. Emory Angioplasty versus Surgery Trial (EAST). *New England Journal of Medicine*. 1994; 331:1044–1050. [PubMed: 8090163]
- van Knippenberg, D. Group norms, prototypicality, and persuasion. In: Terr, DJ.; Hogg, MA., editors. *Attitudes, behavior, and social context: the role of norms and group membership*. Mahwah, NJ: Lawrence Erlbaum Associates Publishers; 2000. p. 157–170.
- Latkin CA, Donnell D, Metzger D, Sherman S, Aramrattana A, Davis-Vogel A, et al. The efficacy of a network intervention to reduce HIV risk behaviors among drug users and risk partners in Chiang Mai, Thailand and Philadelphia, USA. *Social Science & Medicine*. 2009; 68:740–748. [PubMed: 19070413]
- Latkin CA, Sherman S, Knowlton A. HIV prevention among drug users: outcome of a network-oriented peer outreach intervention. *Health Psychology*. 2003; 22:332–339. [PubMed: 12940388]
- Latkin CA, Yang C, Srikrishnan AK, Solomon S, Mehta SH, Celentano DD, et al. The relationship between social network factors, HIV, and Hepatitis C among injection drug users in Chennai, India. *Drug and Alcohol Dependence*. 2011; 117:50–54. [PubMed: 21315523]
- Lewis, MA.; DeVellis, B.; Sleath, B. Social influence and interpersonal communication in health behavior. In: Glanz, K.; Rimer, BK.; Lewis, FM., editors. *Health behavior and health education: Theory, research, and practice*. 3. San Francisco: Jossey-Bass; 2002. p. 240–264.
- Little RJ, D'Agostino R, Cohen ML, Dickersin K, Emerson SS, Farrar JT, et al. The prevention and treatment of missing data in clinical trials. *New England Journal of Medicine*. 2012; 367:1355–1360. [PubMed: 23034025]

- Mathers BM, Degenhardt L, Phillips B, Wiessing L, Hickman M, Strathdee SA, et al. Global epidemiology of injecting drug use and HIV among people who inject drugs: a systematic review. *Lancet*. 2008; 372:1733–1745. [PubMed: 18817968]
- Mausbach BT, Semple SJ, Strathdee SA, Zians J, Patterson TL. Efficacy of a behavioral intervention for increasing safer sex behaviors in HIV-negative, heterosexual methamphetamine users: results from the Fast-Lane study. *Annals of Behavioral Medicine*. 2007; 34:263–274. [PubMed: 18020936]
- Meador N, Semaan S, Halton M, Bhatti H, Chan M, Llewellyn A, et al. An international systematic review and meta-analysis of multisession psychosocial interventions compared with educational or minimal interventions on the HIV sex risk behaviors of people who use drugs. *AIDS and Behavior*. 2013; 17:1963–1978. [PubMed: 23386132]
- Medley A, Kennedy C, O'Reilly K, Sweat M. Effectiveness of peer education interventions for HIV prevention in developing countries: a systematic review and meta-analysis. *AIDS Education and Prevention*. 2009; 21:181–206. [PubMed: 19519235]
- Ministry of Health of Vietnam. HIV/AIDS estimates and projections 2005–2010. Hanoi: Ministry of Health of Vietnam, General Department of Preventive Medicine and HIV/AIDS Control; 2005.
- Ministry of Health of Vietnam. Voluntary HIV counseling and testing (VCT) guidelines (promulgated at the decision no 647/QĐ-BYT dated February 22, 2007 by the Minister of Health. Hanoi: Ministry of Health of Vietnam; 2007.
- National AIDS Commission of Indonesia. Country report on the follow-up to the declaration of commitment on HIV/AIDS. Jakarta: National AIDS Commission, Indonesia; 2008.
- National Institute of Hygiene and Epidemiology. Results from the HIV/STI integrated biological and behavioural surveillance (IBBS) in Viet Nam, 2005–2006. Hanoi: Ministry of Health of Vietnam; 2006.
- NIMH Collaborative HIV/STD Prevention Trial Group. Results of the NIMH collaborative HIV/sexually transmitted disease prevention trial of a community popular opinion leader intervention. *Journal of Acquired Immune Deficiency Syndromes*. 2010; 54:204–214. [PubMed: 20354444]
- Purcell DW, Latka MH, Metsch LR, Latkin CA, Gomez CA, Mizuno Y, et al. Results from a randomized controlled trial of a peer-mentoring intervention to reduce HIV transmission and increase access to care and adherence to HIV medications among HIV-seropositive injection drug users. *Journal of Acquired Immune Deficiency Syndromes*. 2007; 46(Suppl 2):S35–S47. [PubMed: 18089983]
- Quan VM, Chung A, Long HT, Dondero TJ. HIV in Vietnam: the evolving epidemic and the prevention response, 1996 through 1999. *Journal of Acquired Immune Deficiency Syndromes*. 2000; 25:360–369. [PubMed: 11114837]
- Quan VM, Go VF, Nam le V, Bergenstrom A, Thuoc NP, Zenilman J, et al. Risks for HIV, HBV, and HCV infections among male injection drug users in northern Vietnam: a case-control study. *AIDS Care*. 2009; 21:7–16. [PubMed: 19085215]
- Quan, VM.; Hien, NT.; Go, VF. The HIV epidemic in Vietnam: past, present, and opportunities. In: Celentano, DD.; Beyrer, C., editors. *Public health aspects of HIV/AIDS in low and middle income countries*. New York, NY: Springer; 2008. p. 457–480.
- Quan VM, Minh NL, Ha TV, Ngoc NP, Vu PT, Celentano DD, et al. Mortality and HIV transmission among male Vietnamese injection drug users. *Addiction*. 2011; 106:583–589. [PubMed: 21054619]
- Rogers, E. *Diffusion of innovations*. 5. New York, NY: Free Press; 2003.
- Rubin, DB. *Multiple imputation for nonresponse in surveys*. New York: Wiley; 1987.
- Schumacher CM, Go VF, Nam le V, Latkin CA, Bergenstrom A, Celentano DD, et al. Social injecting and other correlates of high-risk sexual activity among injecting drug users in northern Vietnam. *International Journal of Drug Policy*. 2009; 20:352–356. [PubMed: 19010656]
- Semaan S, Des Jarlais DC, Sogolow E, Johnson WD, Hedges LV, Ramirez G, et al. A meta-analysis of the effect of HIV prevention interventions on the sex behaviors of drug users in the United States. *Journal of Acquired Immune Deficiency Syndromes*. 2002; 30(Suppl 1):S73–S93. [PubMed: 12107362]

- Semaan S, Neumann MS, Hutchins K, D'Anna LH, Kamb ML. Brief counseling for reducing sexual risk and bacterial STIs among drug users—results from project RESPECT. *Drug and Alcohol Dependence*. 2010; 106:7–15. [PubMed: 19720471]
- Sherman SG, Latkin CA. Intimate relationship characteristics associated with condom use among drug users and their sex partners: a multilevel analysis. *Drug and Alcohol Dependence*. 2001; 64:97–104. [PubMed: 11470345]
- Sherman SG, Sutcliffe C, Srirojn B, Latkin CA, Aramratanna A, Celentano DD. Evaluation of a peer network intervention trial among young methamphetamine users in Chiang Mai, Thailand. *Social Science & Medicine*. 2009; 68:69–79. [PubMed: 18986746]
- Siegel DM, Aten MJ, Enaharo M. Long-term effects of a middle school-and high school-based human immunodeficiency virus sexual risk prevention intervention. *Archives of Pediatrics & Adolescent Medicine*. 2001; 155:1117–1126. [PubMed: 11576006]
- Thai Nguyen AIDS Center. 2011 Thai Nguyen AIDS Center report. 2011.
- Tobin KE, Kuramoto SJ, Davey-Rothwell MA, Latkin CA. The STEP into action study: a peer-based, personal risk network-focused HIV prevention intervention with injection drug users in Baltimore, Maryland. *Addiction*. 2011; 106:366–375. [PubMed: 21054614]
- Tran TM, Nguyen HT, Yatsuya H, Hamajima N, Nishimura A, Ito K. HIV prevalence and factors associated with HIV infection among male injection drug users under 30: a cross-sectional study in Long An, Vietnam. *BMC Public Health*. 2006; 6:248. [PubMed: 17029648]
- Turner JC. Social comparison and social identity: some prospects for intergroup behaviour. *European Journal of Social Psychology*. 1975; 5:5–34.
- UNAIDS. Report on the global AIDS epidemic. Geneva: Joint United Nations Program on HIV/AIDS (UNAIDS); 2006. http://www.unaids.org/en/media/unaids/contentassets/dataimport/pub/report/2006/2006_gr_en.pdf [Accessed 25.05.12]
- United Nations Office on Drugs and Crime. Vietnam country profile 2005. Hanoi: United Nations Office on Drugs and Crime; 2005.
- Yongvanitjit, K.; Manopaiboon, C.; Aramrattana, A.; Visavakum, P.; Promjuk, W.; Tanpradech, S., et al. Risk behaviors and high HIV prevalence among injecting drug users (IDU) in a respondent driven sampling (RDS) survey in Bangkok and Chiang Mai, Thailand. XVIII International AIDS conference; Vienna, Austria. 18–23 July 2010; Vienna: 2010. Abstract no. TUPE0311 <http://www.iasociety.org/Default.aspx?pageId=11&abstractId=200736160>
- Yu, M.; McGuire, M.; Mathur, M.; Jerajani, H.; Borges, N.; Lindan, C. Sexual risk behavior of injection drug users (IDU) attending STI clinics in Mumbai, India. XVI International AIDS conference; Toronto. 13–18 August 2006; Toronto: 2006. Abstract no. CDD0594 <http://www.iasociety.org/Abstracts/A2191715.aspx>

Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.socscimed.2013.07.006>

Fig. 1.
Flowchart for Vietnam HIV prevention intervention trial.

Fig. 2.
Needle/syringe sharing among networks ($n = 2*417$), using multiple imputations results.

Fig. 3.
Unprotected sex among networks ($n = 2*417$), using multiple imputations results.

Table 1

Sociodemographics and risk behaviors at baseline, among participants enrolled and randomized into the trial.

Variable	Overall N (%)	Control N (%)	Intervention N (%)	Chi-square <i>p</i> -value
Overall	935 (100.0)	466 (100.0)	469 (100.0)	
<i>Males</i>	894 (95.6)	442 (94.9)	452 (96.4)	0.25
<i>Age in years: mean (SD)</i>	32.0 (6.3)	32.1 (6.5)	31.9 (6.2)	0.27 ^a
<i>In what city or district of Thai Nguyen province do you live?</i>				
Thai Nguyen City	904 (96.7)	452 (97.0)	452 (96.4)	0.60
Other ^b	31 (3.3)	14 (3.0)	17 (3.6)	
<i>Current marital status</i>				
Single (never married)	488 (52.2)	242 (51.9)	246 (52.5)	0.72
Currently married	307 (32.8)	150 (32.2)	157 (33.5)	
Widowed	7 (0.8)	5 (1.1)	2 (0.4)	
Divorced	62 (6.6)	29 (6.2)	33 (7.0)	
Separated	60 (6.4)	34 (7.3)	26 (5.5)	
Living with partner but not married	11 (1.2)	6 (1.3)	5 (1.1)	
<i>Highest level of education</i>				
No schooling	3 (0.3)	1 (0.2)	2 (0.4)	0.83
Primary schooling	93 (10.0)	46 (9.9)	47 (10.0)	
Some or completed secondary schooling	388 (41.5)	196 (42.1)	192 (40.9)	
Some or completed high schooling	294 (31.4)	141 (30.3)	153 (32.6)	
Vocational schooling	111 (11.9)	59 (12.7)	52 (11.1)	
Some university/college	30 (3.2)	13 (2.8)	17 (3.6)	
Completed university/college or higher	16 (1.7)	10 (2.2)	6 (1.3)	
<i>Religion</i>				
No religion	894 (95.6)	441 (94.6)	453 (96.6)	0.34
Buddhist	12 (1.3)	7 (1.5)	5 (1.1)	
Catholic	29 (3.1)	18 (3.9)	11 (2.4)	
<i>Ethnic group</i>				
Kinh	854 (91.3)	423 (90.8)	431 (91.9)	0.61 ^d
Tay	48 (5.1)	24 (5.2)	24 (5.1)	
Nung	8 (0.9)	3 (0.6)	5 (1.1)	
San diu	18 (1.9)	12 (2.6)	6 (1.3)	
Other ^c	7 (0.8)	4 (0.9)	3 (0.6)	
<i>Place where you lived or slept most of the time in the past 6 months</i>				
Parents' home	610 (65.2)	302 (64.8)	308 (65.7)	
Own or spouse's home	262 (28.0)	135 (29.0)	127 (27.1)	0.74 ^d
Friend/sexual partner, someone else's home	20 (2.1)	8 (1.7)	12 (2.6)	
On the street, in a park, in an alley, or abandoned buildings (no fixed address)	6 (0.6)	4 (0.9)	2 (0.4)	
Rehabilitation center/Drug treatment center	1 (0.1)	0 (0.0)	1 (0.2)	

Variable	Overall <i>N</i> (%)	Control <i>N</i> (%)	Intervention <i>N</i> (%)	Chi-square <i>p</i> -value
Jail/prison	1 (0.1)	1 (0.2)	0 (0.0)	
Other	35 (3.7)	16 (3.4)	19 (4.1)	
<i>Current employment status</i>				
Working full-time (≥ 30 h/week)	546 (58.4)	274 (58.8)	272 (58.0)	0.88 ^d
Working part-time	127 (13.6)	60 (12.9)	67 (14.3)	
Unemployed	257 (27.5)	130 (27.9)	127 (27.1)	
Other	5 (0.5)	2 (0.4)	3 (0.6)	
<i>Job or profession</i>				
	<i>n</i> = 678			
Driver	113 (16.7)	49 (14.6)	64 (18.7)	0.48 ^d
Manual laborer	343 (50.6)	173 (51.5)	170 (49.7)	
Construction worker	32 (4.7)	15 (4.5)	17 (5.0)	
Factory worker	18 (2.7)	9 (2.7)	9 (2.6)	
Farm worker	63 (9.3)	39 (11.6)	24 (7.0)	
Small business or trader	58 (8.6)	26 (7.7)	32 (9.4)	
Mechanic	17 (2.5)	9 (2.7)	8 (2.3)	
Other	34 (5.0)	16 (4.8)	18 (5.3)	
<i>About how many times did you travel to other provinces in Vietnam in the past year?</i>				
0 times	650 (69.5)	329 (70.6)	321 (68.4)	0.75
1–9	212 (22.7)	101 (21.7)	111 (23.7)	
10+	73 (7.8)	36 (7.7)	37 (7.9)	
<i>About how many times did you travel to Guangxi, China, in the past year?</i>				
0 times	929 (99.4)	463 (99.4)	466 (99.4)	1.00 ^d
1+	6 (0.6)	3 (0.6)	3 (0.6)	
<i>Have you ever smoked, sniffed, or injected drugs in your lifetime?</i>				
No	17 (1.8)	10 (2.1)	7 (1.5)	0.45
Yes	918 (98.2)	456 (97.9)	462 (98.5)	
<i>Have you injected any drugs in the past 3 months?</i>				
No	20 (2.1)	11 (2.4)	9 (1.9)	0.64
Yes	915 (97.9)	455 (97.6)	460 (98.1)	
<i>If yes, how many days did you inject in the past 3 months?</i>				
	<i>n</i> = 915			
Less than daily	247 (27.0)	124 (27.2)	123 (26.7)	
Daily	668 (73.0)	331 (72.8)	337 (73.3)	0.86
<i>Have you ever used a needle that others had used, in the past 3 months?</i>				
No	789 (84.4)	401 (86.0)	388 (82.7)	0.16
Yes	146 (15.6)	65 (14.0)	81 (17.3)	
<i>Have you used any non-injection drugs in the past 3 months?</i>				
No	840 (89.8)	417 (89.5)	423 (90.2)	0.72
Yes	95 (10.2)	49 (10.5)	46 (9.8)	
<i>Have you ever overdosed in your lifetime?</i>				
	<i>n</i> = 918			
No	783 (85.3)	390 (85.5)	393 (85.1)	0.84

Variable	Overall <i>N</i> (%)	Control <i>N</i> (%)	Intervention <i>N</i> (%)	Chi-square <i>p</i> -value
Yes	135 (14.7)	66 (14.5)	69 (14.9)	
<i>When was the most recent time you had sexual intercourse?</i>	<i>n</i> = 934			
Within the past 1 month	412 (44.1)	201 (43.1)	211 (45.1)	0.63
1–3 months	82 (8.8)	41 (8.8)	41 (8.8)	
4–6 months	73 (7.8)	34 (7.3)	39 (8.3)	
More than 6 months	317 (33.9)	160 (34.3)	157 (33.6)	
Never had sexual intercourse	50 (5.4)	30 (6.4)	20 (4.3)	
<i>Have you had any unprotected sex in the past 12 months?</i>				
No	497 (53.2)	259 (55.6)	238 (50.7)	0.14
Yes	438 (46.8)	207 (44.4)	231 (49.3)	
<i>Number of sexual partners in lifetime: median [IQR]</i>	4 [2–7]	4 [2–7]	4 [2–7]	0.76 ^e
<i>In the past 30 days, how many days have you drunk alcohol?</i>	<i>n</i> = 934			
0 days	307 (32.9)	152 (32.6)	155 (33.1)	0.47
1–29	468 (50.1)	240 (51.5)	226 (48.3)	
30	161 (17.2)	74 (15.9)	87 (18.6)	
<i>Have you ever been incarcerated (that is being put in prison, jail, or detention center) in your lifetime?</i>				
No	602 (64.4)	306 (65.7)	296 (63.1)	0.42
Yes	333 (35.6)	160 (34.3)	173 (36.9)	

^a *p*-value calculated using *t*-test.

^b Other cities/districts include: Song Cong, Dai Tu, Dinh Hoa, Dong Hy, Phu Binh, or Phu Luong.

^c Other ethnicities include: San chi (trai), Hoa, Dao (man), or other.

^d Because one or more cell(s) has an expected count of less than 5, this *p*-value is based on Fisher's Exact Test.

^e *p*-value calculated using Wilcoxon Rank Sum Test.

Table 2

HIV seroconversions among index participants during follow-up.

Visit no.	Baseline	3-Month	6-Month	9-Month	12-Month
<i>Control</i>					
No. at risk	208	177	173	148	115
No. of events	0	4	0	1	1
Percent Incidence in 3 months	0	2	0	1	1
Percent estimated without HIV	100	98	98	97	96
<i>Intervention</i>					
No. at risk	209	177	170	144	114
No. of events	0	7	0	1	1
Percent incidence in 3 months	0	4	0	1	1
Percent estimated without HIV	100	96	96	95	95

Logrank test over follow-up = 0.6, $p = 0.43$.

Table 3

Percent and standard error (SE) of participants who used others' needle/syringe in the past 3 months.

Visit no.	Baseline	3-Month	6-Month	9-Month	12-Month	Wald test for visits 3-12 months
<i>For indexes (n = 417)</i>						
Control (% observed)	(100)	(71)	(67)	(65)	(57)	
Observed data only: %(SE)	13 (2)	3 (1)	4 (2)	1 (1)	3 (1)	
Multiple imputations: %(SE)	13 (2)	3 (1)	3 (1)	0 (0)	1 (0)	
Intervention (% observed)	(100)	(74)	(70)	(65)	(58)	
Observed data only: %(SE)	14 (2)	3 (1)	2 (1)	1 (1)	2 (1)	
Multiple imputations: %(SE)	14 (2)	3 (1)	2 (0)	7 (3)	4 (2)	
Effect (I-C)						
Observed data only: %(SE)	1 (3)	0 (2)	-2 (2)	0 (1)	-1 (2)	
Multiple imputations: %(SE)	1 (3)	0 (1)	-1 (1)	6 (3)	3 (2)	$W = 3.74, p = 0.44$
<i>For nonindex matched members (n = 417)</i>						
Control (% observed)	(100)	(68)	(62)	(56)	(47)	
Observed data only: %(SE)	13 (2)	3 (1)	1 (1)	0 (0)	1 (1)	
Multiple imputations: %(SE)	13 (2)	3 (1)	0 (0)	0 (0)	0 (0)	
Intervention (% observed)	(100)	(65)	(62)	(60)	(51)	
Observed data only: %(SE)	22 (3)	4 (2)	1 (1)	1 (1)	0 (0)	
Multiple imputations: %(SE)	22 (3)	3 (1)	0 (0)	2 (1)	0 (0)	
Effect (I-C)						
Observed data only: %(SE)	9 (4)	2 (2)	0 (1)	1 (1)	-1 (1)	
Multiple imputations: %(SE)	8 (4)	0 (2)	0 (1)	2 (1)	0 (0)	$W = 5.05, p = 0.28$

Table 4

Percent and standard error (SE) of participants who had unprotected sex in the past 3 months, except for baseline, which is in the past 12 months.

Visit no.	Baseline	3-Month	6-Month	9-Month	12-Month	Wald test for visits 3-12 months
<i>For indexes (n = 417)</i>						
Control (% observed)	(99)	(71)	(67)	(65)	(57)	
Observed data only: %(SE)	49 (3)	28 (4)	30 (4)	28 (4)	37 (4)	
Multiple imputations: %(SE)	49 (3)	27 (4)	31 (4)	26 (4)	37 (4)	
Intervention (% observed)	(100)	(74)	(70)	(65)	(58)	
Observed data only: %(SE)	53 (4)	27 (4)	35 (4)	31 (4)	28 (4)	
Multiple imputations: %(SE)	53 (4)	28 (3)	36 (4)	35 (4)	27 (4)	
Effect (I-C)						
Observed data only: %(SE)	4 (5)	-1 (5)	5 (6)	3 (6)	-9 (6)	
Multiple imputations: %(SE)	4 (5)	1 (5)	5 (6)	9 (6)	-10 (5)	$W = 10.8, p = 0.03$
<i>For nonindex matched members (n = 417)</i>						
Control (% observed)	(100)	(68)	(62)	(56)	(47)	
Observed data only: %(SE)	46 (3)	30 (4)	27 (4)	26 (4)	30 (5)	
Multiple imputations: %(SE)	46 (3)	29 (4)	25 (4)	27 (4)	28 (4)	
Intervention (% observed)	(100)	(65)	(62)	(60)	(51)	
Observed data only: %(SE)	48 (3)	24 (4)	21 (4)	25 (4)	21 (4)	
Multiple imputations: %(SE)	48 (3)	26 (4)	24 (4)	24 (4)	19 (3)	
Effect (I-C)						
Observed data only: %(SE)	2 (5)	-6 (5)	-6 (5)	-1 (6)	-8 (6)	
Multiple imputations: %(SE)	2 (5)	-4 (6)	1 (6)	4 (5)	-9 (5)	$W = 3.47, p = 0.48$

Table 5
Entry date and percent and standard error (SE) of indexes who used others' needle/ syringe in the past 3 months.

Visit no.	Baseline	3-Month	6-Month	9-Month	12-Month
<i>Entry date</i>					
<i>First 198 days (N = 209)</i>					
(% observed)	(100)	(74)	(70)	(67)	(67)*
Percent used (SE)	12 (2)	2 (2)	3 (1)	1 (1)	2 (1)
<i>Last 198 days (N = 208)</i>					
(% observed)	(100)	(70)	(67)	(63)	(48)*
Percent used (SE)	15 (2)	3 (1)	3 (1)	1 (1)	2 (1)

Pattern of missed visits and percent and standard error (SE) of indexes who used others' needle/syringe in the past 3 months. Highlighted are the patterns with criteria (a) and (b) as defined in the text, and the visits t1 and t2 within each such pattern as defined in the text.

Table 6

Visit no.		Baseline	3-Month	6-Month	9-Month	12-Month
Pattern	N	Percent who use other's needle/syringe in the past three months				
Monotone:						
10000	61	23				
11000	27	19	0			
11100	23	17	0	4		
11110	50	0	2	0	2	
11111	179	14	3	3	1	2
All monotone (% observed)	340	(100)	(82)	(74)	(67)	(53)
Percent used (SE)		14 (2)	2 (1)	3 (1)	1 (1)	2 (1)
Nonmonotone:						
11101	5	20	20	0		20
11011	10	10	20		0	0
11001	7	0	0			0
10111	15	7		0	0	0
10011	6	0			0	0
10110	7	0		0	0	
10101	4	25		0		0
10001	14	14				7
10100	4	0		25		
10010	5	40			0	

Table 7

Pattern of missed visits, stratified by study arm, and percent of indexes who had unprotected sex in the past 3 months, except baseline which is in the past 12 months.

Visit no.	Baseline		3-Month		6-Month		9-Month		12-Month	
Pattern	Arm ^a	N	%							
<i>Monotone:</i>										
10000	C	30	40							
	I	31	52							
11000	C	17	41	6						
	I	10	60	50						
11100	C	6	67	50	33					
	I	16	44	19	31					
11110	C	27	44	22	19	22				
	I	22	59	23	36	32				
11111	C	83	52	33	35	25	28			
	I	94	56	28	37	34	30			
All monotone	C	163	48				28			
	I	173	55				30			
<i>Nonmonotone:</i>										
11101	C	3	67	33	33		67			
	I	2	100	50	50		0			
11011	C	4	50	50		75	50			
	I	6	50	30		33	33			
11001	C	4	50	25			50			
	I	3	0	0			0			
10111	C	11	45		27	45	64			
	I	4	25		0	0	0			
10101	C	1	100		100		100			
	I	3	67		33		33			
10011	C	3	67			33	67			
	I	3	67			0	0			
10001	C	8	75				50			

Visit no.					Baseline	3-Month	6-Month	9-Month	12-Month
Pattern	Arm ^a	N			%				
All non-monotone with observed 12-month visit	I	6			33				50
	C	34			59	36	33	50	59
10110	I	27			44	27	22	15	22
	C	3			33		0	0	
10100	I	4			25		50	0	
	C	3			0		0		
10010	I	1			0		0		
	C	2			100			50	
All with 1AB1? where at least one of A, B is 0	I	3			67			33	
	C	23			52	50	21	43	61
All with 1111?	I	20			45	33	25	15	15
	C	110			50	30	31	25	28
	I	116			57	27	37	34	30

^aC for control, I for intervention.