# THE INFLUENCE OF A PEER-BASED HIV PREVENTION INTERVENTION ON CONVERSATION ABOUT HIV PREVENTION AMONG INJECTION DRUG USERS IN BALTIMORE, MARYLAND

by
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## Abstract

*Background*

STEP into Action assessed the effectiveness of a peer-based HIV prevention intervention on the reduction in risk behaviors among injection drug users (IDUs) in Baltimore. This analysis examined the effect of the peer-based intervention on (i) the change in frequency of conversation about HIV prevention topics over time among IDUs, (ii) sustainability of the change in frequency of the conversation, and (iii) which topics IDUs were more likely to discuss at the end of the follow-up period.

*Methods*

Of 227 Index participants 114 were randomized into intervention and 113 into control group. Participants were 18 years of age or older and self-reported injecting drugs in the 6 months prior to enrollment in the trial. Data were collected prospectively at 6, 12, and 18 months. The outcome of interest was the frequency of conversation among IDUs about different HIV prevention topics.

*Results*

Retention of the participants in the study exceeded 80% for each of the 3 visits. The odds of talking 'at least a few times a week' compared to 'never' about HIV testing (odds ratio (OR) = 1.86; 95% confidence interval (CI) = 0.87 - 3.95), HIV transmission (OR = 3.22; 95% CI = 1.39 - 7.46), needle cleaning (OR = 4.35; 95% CI = 1.88 - 10.07), needle sharing (OR = 4.35; 95% CI = 1.80 - 10.54), and

condom use (OR = 2.25; 95% CI = 1.05 - 4.84) were higher in the intervention group compared to the control group at 6 months. At 18 months odds ratios that remained statistically significant were only for conversation about the danger of needle sharing (odds ratio (OR) = 3.21; 95% CI = 1.45 - 7.14) and condom use (OR = 2.81; 95% CI = 1.28 - 6.17).

*Conclusions*

This study demonstrated that the intervention had a positive influence on the conversation about HIV prevention among IDUs, but the sustainability of the high frequency of conversation past 6 months remained a challenge for most of the conversation topics. Thus, the findings suggest that interventions should be designed to constantly reinforce positive behavior among IDUs.

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## Tables, and Figures

# Chapter 1: Introduction

Despite the existence of effective methods for prevention of HIV transmission and numerous public health interventions over the past 30 years, there were nevertheless 2.5 million new HIV infections in the world (UNAIDS, 2012) in 2011. New infections pose an especially great challenge among the most-at-risk populations: men who have sex with men (MSM), commercial sex workers (CSW) and injection drug users (IDUs). In the US alone there are about 50,000 new HIV infections per year, most of which occur in the most-at-risk populations (CDC, 2013).

In the United States, HIV and drug abuse are major public health problems in the urban setting (Latkin *et al.*, 2006). Since the mid-1980s, injection drug use has been one of the main driving forces of the HIV epidemic in the United States (Rudolph *et al.*, 2003). In 2010, 8% (CDC, 2012) of new HIV infections in the USA were among IDUs. Nearly 182,000 injection drug users diagnosed with AIDS have died since the beginning of the HIV epidemic; in 2010 alone 4,218 IDUs died due to AIDS (CDC, 2013).

Baltimore has a large population of injection drug users. The 2011 National Survey on Drug Use and Health estimates that 10.21% of Baltimore City residents 18 and older have abused drugs or alcohol within the past year (BCHD, 2012). This amounts to approximately 63,400 individuals based on 2010 Census data (BCHD, 2012). HIV incidence among IDUs in Baltimore remains high, accounting for 36.5% new cases in 2011 (DHMH, 2012). Over the last 30 years HIV prevalence among IDUs in Baltimore fluctuated greatly and has historically

been high, starting at 31% in 1985, peaking at 66% in 1992 and dropping to 12% by 2011 (DHMH, 2012). Despite this recent decrease, there are nevertheless 4,159 IDUs living with HIV, who account for 42.7% of all the HIV cases in Baltimore (DHMH, 2012). The majority of IDUs living with HIV, 3,675 (88%), are African-American. In Baltimore, injection drug users are mostly African-American men in their mid 30s of low socio-economic status (many of them did not complete high school education and are unemployed) (Villanti *et al.*, 2012).

Fundamental to HIV transmission among IDUs are their risky behaviors related to preparation and distribution of drugs for injection and sharing of the injection equipment, such as needles, drug mixing containers (cookers or spoons), cotton filters, and water for mixing drugs into solution and for rinsing syringes (Koester *et al.*, 2005). Needle sharing has declined over the years (Mehta *et al.*, 2006), but risky drug splitting practices still prevail and contribute to the perpetuation of HIV (De *et al.*, 2009). A study among 611 heroin IDUs in Denver showed high-risk injection practices in particular sharing of contaminated drug solutions. In the cohort of 304 heroin injecting networks, 82% reported dividing the liquid drugs, 67% used a reservoir of water that syringes had been rinsed in to mix drugs, 86% used a common cooker, and 58% reported sharing a cotton filter. Only 22% shared syringes (Koester *et al.*, 2005).

Numerous public health interventions among IDUs such as needle exchange programs (NEPs), drug user treatment and peer-based outreach have resulted in a decrease in HIV transmission among IDUs. NEPs directly reduce rates of HIV transmission among IDUs by providing clean injecting equipment and removing contaminated needles and syringes from circulation in the community (Vlahov *et al.*, 2001). NEPs are also effective in referring IDUs to

treatment programs (Latkin *et al.*, 2006). Drug user treatment programs can reduce or stop drug use, resulting indirectly in reduction of HIV transmission (Vlahov *et al.*, 2001). Studies have confirmed this by showing that drug user treatment is positively associated with drug use cessation and low HIV incidence (Metzger *et al.*, 1998).

In addition to NEPs and drug user treatment programs, peer-based education is another highly effective method to prevent HIV transmission among IDUs. Studies have shown that training peer leaders in how to promote HIV risk reduction has had a positive influence on them and their community (Latkin, 1998). Peer leaders have reported significant increase in condom use and cleaning of used needles with bleach (Latkin, 1998). Their risk networks compared to controls' RNMs were also more likely to report used needle cleaning (Latkin, 1998). Nevertheless, risky injecting behaviors persist within this population and thus HIV prevalence among IDUs in Baltimore remains high, 12% in 2011 (DHMH, 2012).

Peer-based education is effective in reducing risk behaviors among IDUs (Latkin, 1998). One of the important elements of the peer-based education is conversation about HIV prevention (Davey-Rothwell and Latkin, 2007). Thus far, cross-sectional studies have shown positive association between conversation about HIV prevention methods among IDUs and reduction in their risk behaviors (Des Jarlais *et al.*, 1995; Gibson *et al.*, 1993). However, no one has reported the specific conversation topics that IDUs discuss, the frequency of these conversations as well as whether peer-based interventions continue to have a positive effect on the frequency of conversation about HIV prevention topics over time. Since conversation plays an important role in peer-based education it

is important to assess HIV prevention conversation patterns among IDUs in order to adapt intervention methods that will be more effective in reducing risky injecting and sex behaviors among IDUs. This study aims to determine the effect of a peer-based educational intervention on change in frequency of conversation and sustainability of conversation about HIV prevention topics over time among IDUs in Baltimore, Maryland.

# Chapter 2: Literature review

*2.1 Peer-based education and the basis for peer-based approaches to reduction of HIV risk behavior among IDUs*

Peer-based interventions for HIV prevention are cost-effective (Latkin *et al.*, 2004) and have proven effective in promoting reduction in HIV risk behavior among different populations (Kelly *et al.*, 2002). Numerous studies have focused on IDUs' social networks and reduction in HIV risk behaviors in those networks. These interventions are based on various social influence theories such as the 'risk environment' framework (Rhodes *et al.*, 2009), diffusion of innovative theory (Rogers, 2003), social learning (Bandura, 1977), social identity (Turner, 1978) and others (Latkin *et al.*, 2009).

A 'risk environment' framework is applied to the reduction in risk behavior among IDUs by considering physical, social, economic factors as well as the policy micro- and macro-environment. This framework suggests that risk behavior is dependent on the social context defined by the interactions between individuals and their environment. Further, understanding of these interactions helps frame the approach towards risk reduction (Rhodes *et al.*, 2009). For example, a study of 226 heroin detoxification clients showed that injection of drugs in shooting galleries or other public places increased the odds of sharing dirty needles, while the chance of sharing needles decreased sharply as a function of drug users' self-efficacy (Gibson *et al.*, 1993). This suggests that counseling maybe needed to help drug users develop confidence in resisting needle sharing.

Diffusion of innovative theory (Rogers, 2003) suggests that altering behavior in social networks is possible. According to the theory the population adopts the new innovative behavior if there are enough individuals modeling and promoting the new behavioral trend within the population. These individuals are called popular opinion leaders (POLs). In the numerous HIV prevention intervention studies those individuals were identified in the populations of interest and trained to promote HIV prevention methods in their social networks through everyday conversation. Interventions based on the diffusion of innovative theory have proven to be very effective among MSM. A number of studies based on the POL approach have consistently shown 30% reduction from baseline in high-risk sexual behaviors among MSM (Kelly *et al.*, 2002).

Based on social identity and social learning theories for peer-based interventions, it is important to consider that not all members of a social network have the same influence on risk behavior (Reifman *et al.*, 2006). Latkin *et al.* (1995) showed that those with whom individuals use drugs have more influence on their risk behavior related to drug use than family or friends, supporting a peer-based approach to risk reduction among IDUs. In addition, peer-based interventions are more effective than traditional HIV prevention outreach conducted by paraprofessional street outreach workers (Dickson-Gomez *et al.*, 2006). This is based on the following social dynamics within the networks: i) peers are considered a more credible and influential source of information, because the individuals in a social network identify with each other and peers are culturally and ethically more similar to the target population; ii) since peers are part of the social network they have access to established routes of

communication and can more easily disseminate the information as well as reach drug users that would otherwise be hard to reach; iii) peers are able to deliver risk prevention information to drug users at the sites and times when high risk behaviors are most likely to take place (Broadhead *et al.*, 1995; Latkin, 1998). To support these arguments results of The Risk Avoidance Partnership intervention were examined. This intervention trained active drug users to be peer health advocates (PHAs) and promote risk reduction among their peers (Dickson-Gomez *et al.*, 2006). Results indicate that PHAs were considered a credible and trustworthy source of information for HIV prevention by their drug-using peers (Dickson-Gomez *et al.*, 2006).

Several studies showed that peer-based interventions influence the change in behavior not only among the network members but also among the peer educators themselves, which makes the HIV prevention message to peers even more credible. In the Self-Help in Eliminating Life-Threatening Diseases (SHIELD) study of a network-oriented HIV prevention intervention, HIV positive and negative drug users were targeted through peer outreach. 250 drug users were randomly assigned to a control group or an intervention group, which encouraged peer outreach. Those in the intervention group were 3 times more likely to report reduction of injection risk behaviors and 4 times more likely to report increased condom use with casual sex partners compared to the control group (Latkin *et al.*, 2003).

Another study that showed a positive association between peer-based education and reduction in HIV risk behavior among IDUs was The HIV Prevention Trials Network study conducted among the injection drug users in

Chiang Mai, Thailand and Philadelphia, USA. A large decrease in the number of participants reporting injection risk behaviors was observed between baseline and follow-up in both arms at both sites. After the intervention, Index participants randomized into the intervention group talked more about HIV risk and prevention compared to Index participants in the control group. As a result of an intervention, a 37% reduction in the odds of sharing cottons was observed, a 20% reduction in using rinse water, a 26% reduction in sharing cookers and a 24% reduction in sharing syringes (Latkin *et al.*, 2009). Another randomized controlled trial among 419 HIV-negative index IDUs and 516 their injecting and sexual network members in Thai Nguyen, Vietnam showed that peer-based education resulted in a significant drop in unprotected sex, from 49% to 27%, among all index-network pairs, and a significant drop in needle/syringe sharing, from 14% to 3% (Go *et al.*, 2013).

In conclusion, all the studies that we have examined provide sufficient evidence that peer-based education is an effective way to successfully promote HIV prevention and to reduce injecting and sex risk behaviors among IDUs.

*2.2 Communication*

Verbal communication plays an important role in the success of the peer educational interventions since it is the main agent for establishing, altering and maintaining social norms (Davey-Rothwell and Latkin, 2007). Nevertheless, little is known about the patterns of conversation about HIV-related topics among IDUs and how peer-based interventions influence HIV prevention conversation in this population over time.

Research on safe sex behavior in different populations showed that

increased conversation about, for example, use of condoms was significantly associated with a change in behavior and increased practice of safe sex. A study among the male partner of the female sex workers found that communication about condoms with social network contacts was significantly associated with consistent condom use (Barrington *et al.*, 2009). In another study among female entertainment workers the use of condoms was positively associated with the co-workers trying to convince them to use condoms and significantly associated with following through with the advice (Urada *et al.*, 2013). In a study of commercial sex male clients HIV-related communication was significantly associated with consistent condom use among clients who visited female sex workers (FSWs) with friends (Yang *et al.*, 2010). Social media study of MSM revealed that those who engaged in a virtual conversation (on Facebook) about HIV prevention and testing were significantly more likely to request an HIV testing kit (Young and Jaganath, 2013).

Less research has been conducted on the HIV related communication and reduction in risk behavior among IDUs, but there are some studies from the 1990s which reported a positive association between HIV-related communication and reduction in injecting and sex risk behaviors among IDUs. Among the participants in short-term residential detoxification program for the improvement in drug using behavior, one particularly important factor was the number of people that IDUs talked to about safe drug use (Zapka *et al.*, 1993). A cross-sectional study of IDUs in four cities (Bangkok, Glasgow, New York City and Rio de Janeiro) reported reduction in sex and injecting risk behavior among IDUs if they engaged in conversation about HIV/ADIS with their drug using partners and sex partners (Des Jarlais *et al.*, 1995).

Some studies have explored the characteristics of IDUs who are more likely to talk about HIV prevention topics with their peers and the context in which conversations take place. Latkin *et al.* (2004) in the study consisting of 156 peer outreach educators within the drug-using community showed that there are demographic and risk behavior differences in terms of those who talk about HIV prevention topics to their network members. The researchers reported that 6 months after the 10–session training, older participants (age 41 and older) and HIV-positive participants were more likely to engage in HIV prevention conversation with their network members, while current drug users were less likely to talk about HIV related topics. Further, Davey *et al.* (2007) examined the context in which HIV prevention conversation tends to take place. Cross-sectional analysis of the baseline data in the randomized trial of 684 IDUs showed that the most common situations in which HIV-related conversation took place were while getting high, when someone from the network got HIV, while 'hanging out', and when someone in the network got HIV testing.

These studies show that demographic characteristics, drug use, HIV status and context of the conversation are associated with HIV prevention conversation among IDU network members and should be taken into account when developing future peer-based HIV prevention interventions for IDUs. In addition, communication is a way of promoting a change in behavior and studies among IDUs have confirmed that communication plays an important role in reducing risky sex and injecting behavior in this population. Thus, understanding communication is important in developing effective peer-based HIV prevention interventions among IDUs.

## Chapter 3: Objectives and Rationale of Study

STEP into Action was a randomized controlled trial conducted between March 2004 and March 2006 among IDUs in Baltimore, Maryland. The study trained active injection drug users to be health educators and perform outreach specifically in their personal social network among their injecting and/or sexual partners. The aim of the study was to assess the effectiveness of a peer-based HIV prevention intervention to (1) train injection drug users (IDUs) to reduce injection and risky sex behaviors, (2) conduct outreach to their personal social networks, and (3) reduce risk network members (RNMs) HIV risk behaviors (Tobin *et al.*, 2011).

Peer education is a very effective way of reducing the injecting and sex risk behaviors among IDUs. As we have seen in the prior chapter, communication about HIV prevention topics plays an important role in the success of peer-based interventions. Yet, very little is known about the patterns of HIV prevention conversation and effect of interventions on conversation among IDUs. This analysis examines the change in the frequency of conversation about HIV prevention topics as a result of a peer-based intervention over time. In particular the longitudinal nature of the study allowed us to examine whether the change in the frequency of communication is sustained over time. Understanding how the peer-based interventions affect the communication about HIV prevention among IDUs will enable us to devise and implement more effective interventions for reduction of sex and injecting risk behavior among IDUs.

Specifically, this study aims to answer three main questions:

1. How does the frequency of conversation about HIV prevention topics as a result of peer-based intervention change over time?
2. Is the frequency of conversation about HIV prevention sustained over time?
3. Do IDUs preferentially discuss some HIV prevention topics over others and how does this trend change over time?

# Chapter 4: Methods

*4.1 Study design and study population*

This is a randomized controlled trial of injection drug users with baseline information and prospective data collected at 6, 12 and 18 months. There were two types of participants in this study: Index and RNMs. For Index participants, the inclusion criteria were: age 18 and older, reported injection drug use in the past 6 months, residency in Baltimore city, willing to recruit RNM into the study and to have HIV prevention conversations. Index participants who recruited RNMs into the study were eligible for randomization. Only Indexes participated in the group sessions in the intervention and control arms. For the purpose of exploring the direct effect of the intervention on the change in frequency of conversation over time, this analysis included only the Index population, and RNMs were excluded from the analysis.

*4.2 Recruitment*

Study participants were recruited from March 2004 to March 2006 in Baltimore. Index participants were recruited through street-based outreach, word of mouth and advertisements posted throughout the community. At the baseline visit, participants were consented. All participants signed informed consent forms before data was collected. At the baseline visit, using an interviewer-administered survey, information was collected on demographics, health status, drug and alcohol use as well as frequency of communication about HIV topics (Tobin *et al.*, 2011). Risky sexual and injection practices were assessed

using an audio computer-assisted self-interview (ACASI). HIV status was self-reported and all the participants were offered an HIV antibody test using Orasure technology. All the study procedures were conducted at a community-based research clinic. Participants received $30 for the completion of the baseline visit (Tobin *et al.*, 2011). The Johns Hopkins Bloomberg School of Public Health Institutional Review Board approved this research study.

*4.3 Randomization*

Index participants were stratified by gender and then randomized using blocking method (size of the each block was four). Stratification by gender assured equal number of men and women in each group (Tobin *et al.*, 2011). 600 Index participants were recruited for the study. 297 of these recruited at least one RNM, and 227 were randomized into intervention (n=114) and control (n=113) groups (Figure 1).

*4.4 Intervention condition*

The intervention consisted of information about an HIV prevention and teaching Index participants the skills needed to promote risk reduction within their personal risk networks. It was composed of seven sessions, five of which were group-based. The topics discussed at five group sessions were: introduction to the health educator role and communication, reducing injection and drug splitting risk behavior, sex risk reduction and use of condoms, credibility as a health educator, graduation and sustainability of skills (Tobin *et al.*, 2011). One was an individual session with an Index participant and one was a session in which both Index and their RNMs participated (dyad session) (Tobin *et al.*, 2011).

The small-group sessions were designed to be interactive such that the participants were role-playing and demonstrating the skills and learning from observing their peers or the facilitators. Topics of the group sessions included: peer-educator communication skills, reducing injection and drug splitting risk behaviors (such as using syringes without needles to split liquid drugs and laminated sheets for dry drugs). The individual sessions with index participants included goal-setting for the individual HIV risk reduction and outreach work. The session with Indexes and their RNMs allowed Indexes to teach the HIV risk reduction methods and to set goals for HIV risk reduction with their RNMs (Tobin *et al.*, 2011).

Attendance for the intervention session was high. 87% of the participants attended at least 4 out of 7 sessions. 36% attended all the sessions and 64% completed a session with their RNMs (Tobin *et al.*, 2011). Sessions were audio-recorded and fidelity to the intervention was assessed at random. Two independent trained research assistants reviewed recordings of the sessions for adherence to the content and procedures of the intervention. Adherence was high; over 90% of the sessions were rated as adequate (Tobin *et al.*, 2011).

*4.5 Control condition*

The control condition consisted of five-group sessions (HIV 101 and testing, hepatitis 101, drug treatment, overdose risk factors, and overdose prevention) during which Index participants received information on injection-drug use topics and were not taught skills for HIV risk reduction. Co-facilitators were the same for the control and intervention groups. 85% of the Index participants attended 3 out of 5 sessions. Audio recordings of the sessions were

assessed for the potential contamination of the information by the information shared with the intervention group. Participants received $20 for their participation in each session (Tobin *et al.*, 2011).

*4.6 Follow-up data collection*

Participants were followed for 18 months after the last intervention or control session. Data was collected at 6, 12, and 18 months (T2, T3, and T4) since the last session. In the follow-up visits participants completed an interviewer-administered survey. Interviewers were blinded to the study condition of the participants. Participants were compensated $35 for every follow-up visit. More than 85% of Index participants were retained in each study visit, Figure 1.

*4.7 Outcome measures*

One of the goals of the intervention was to increase the frequency of communication about HIV prevention topics between Index participants and their "drug buddies." Outcome measures for this analysis focused on communication between Index participants and their drug buddies about five HIV prevention topics: HIV testing, HIV transmission, needle cleaning with bleach, dangers of sharing needles with other people and use of condoms during sexual intercourse. All of these outcomes had 8 ordered categories (talking: never; once or twice a year; once a month; a few times a month; once a week; a few times a week; once a day; and more than once a day). Based on the scientific question and on the distribution of the outcomes, which was very similar for all the outcome variables at the baseline and not normal (Figure 2.), we have grouped 8 categories into 3 categories (never = talking never or once or twice a

year; at least once a month = once a month or a few times a month or once a week; at least few times a week = a few times a week or once a day or more than once a day).

The section of the questionnaire that contained five outcome variables of interest was skipped if participants reported not using heroin, cocaine or crack within past year. All the randomized Index participants had a response for the outcome variables at the baseline. At the 6-month visit, a response for the outcome variables was recorded for 80% of the Index participants. At the 12-month and 18-month visits, responses were recorded for 77% and 67% of Index participants, respectively. However, intervention and control groups remained comparable throughout follow-up visits based on their baseline characteristics.

### *4.8 Potential covariates*

Socio-demographic characteristics included gender, age, race, education and homelessness in the past 6 months from the baseline visit. Risk behaviors that were considered potential covariates were: exchanging sex in the past 90 days (from the baseline visit) for money, food, dugs or shelter and daily injecting of the drugs in the past 6 months (from the baseline visit).

### *4.9 Statistical analysis*

#### *4.9.1 Data management*

We merged four rounds of data (baseline, 6-month, 12-month, 18-month) for the purposes of the longitudinal data analysis. The sample for the analysis was restricted to 227 Index participants. Missing data was handled using model-wise deletion.

*4.9.2 Data analysis*

A Chi-square test for categorical and a t-test for continuous variables were used to compare baseline demographic characteristics for the Index participants by intervention assignment. Comparability between the two groups at each visit was explored with univariate logistic regression based on the baseline values for demographic characteristics. Univariate multinomial logistic regression was used to assess the association between the outcome and participants' demographic characteristics. Patterns of missing data were examined with univariate logistic regression to explore whether missingness of the outcome was informative based on the outcome reported in previous visits and based on the baseline covariates.

To examine the intervention effect on Index behavior over the 18-month period we used multinomial logistic regression accounting for clustering by individual (Rabe-Hesketh and Skrondal, 2012). In the model an independent correlation structure was assumed and standard error was calculated using the robust variance estimate to account for the potential correlation misspecification. An indicator variable for the four visits was included as a covariate in the model. Interaction terms between the visits and the intervention status were also included to assess whether the effect of intervention varied across time. Assessment of the comparability between the intervention and control group across time based on the potential confounders (baseline characteristic) suggested that it was not necessary to include covariates in the models since the randomization was preserved across visits. Data were analyzed based on the intent-to-treat assumption. Analysis was conducted using STATA, version 13.0 (STATA Corporation, 2013).

# Chapter 5: Results

The study enrolled 227 Index participants of which 114 were randomized into an intervention and 113 into a control group (Figure 1). Demographic characteristics and selected risk behaviors of the Index participants are presented in Table 1 (for the purpose of describing the population, Table 1 contains more characteristics than what we considered as potential confounders in our analysis, see section 4.8). IDUs in the two groups were comparable based on their baseline characteristics. 55% of the Index participants were male. The average age of the participants was about 43 years. Most of the participants, 85%, were African American. 45% of the participants completed 12$^{th}$ grade or higher education. Unemployment in the past 6 months from baseline visit was very high, 92%. About one-fourth of participants were in prison in the past 6 months from the baseline visit. A large number of participants engaged in risky injecting and sex behaviors, 48% daily injected in past 6 months from baseline visit, 41% used unclean needles, and 65% used unclean cottons or cookers. 66% of the participants reported having one main sex partner, 34% had two or more sex partners and among those who reported having sex in the prior 90 days from the initial visit 23% were exchanging sex for food, shelter, drugs or money.

The missing data pattern was the same for all five outcome variables. The questions about HIV prevention communication between Index participants and their injecting buddies were asked only if Indexes reported injecting in the prior 6 months. Thus, there were more responses missing for the HIV prevention conversation among IDUs as compared to overall missing of the participants in

the follow-up visits shown in Figure 1. All 227 participants had data for 5 outcome variables at the baseline visit whereas 20% of the data was missing at the 6-month visit, 23% at the 12-month visit and 33% at the 18-month visit. However, univariate analysis of missing responses on the baseline data collected for potential confounders revealed that there was no difference between Index participants who responded to the questions and those who did not, Table 2.

Missingness was also explored based on outcomes reported in prior visits. The univariate analysis presented in Table 3 shows that most of the outcomes were independent of the Index participants' response in prior visits. However, significant differences were noted in several responses. Based on the baseline response to frequency of conversation about danger of needle sharing those who reported talking 'at least once a month' were 56% ($p<0.05$) less likely to be missing the response at the 18-month visit than those who responded 'never' at baseline. Similarly, those who responded talking more than 'never' about condom use at the baseline were less likely to be missing the response at the 6-month and 12-month visits than those who reported 'never' talking about condom use at the baseline. Finally, those who at the 6-month visit reported talking about getting HIV testing 'at least a few times a week' had 3.6 ($p<0.01$) times higher odds of missing a response at the 18-month visit compared to those who responded 'never' at the 6-month visit. However, when fitting the interaction between the responses in the prior visits with the assignment to the intervention, significant differences were not found in terms of missing responses on outcome in the previous visits comparing intervention to control groups (data not shown). Thus, it was assumed that missingness was random.

For the analysis of this data we used a marginal model to estimate the population mean. Multinomial logistic regression was used with assumption of the independent correlation structure for the within subject responses. Based on the data in Table 4 we observed some correlation in responses for each individual. On average, 55% of the individual responses were the same over time. For example, overall, 35% of the responses among Index participants are talking 'at least once a month' about getting HIV testing to their drug buddies. 147 Index participants reported talking 'at least once a month' about getting HIV testing at one of their visits. Among these, on average 53% of the individual responses were talking 'at least once a month' about getting HIV testing. Since we assumed independence within subject repeated responses to correct for any misspecification of the correlation we used robust variance estimates.

The final model for the analysis contained only the intervention assignment, time representing visits spaced in 6-month intervals, and interaction between the time and intervention assignment. The decision not to control for any other covariates in the model was based on the univariate analysis presented in Table 5. Based on the baseline values for the covariates that were considered potential confounders in association between intervention assignment and outcomes, we assessed whether the intervention and control groups remained comparable across time. Table 5 compares the two groups and supports the decision of not including more covariates in the model. In addition, sensitivity analysis was performed by adding gender, age, race and education level (data not shown) to the final model; this showed that the estimates did not change, suggesting that the decision to exclude covariates from the final model was appropriate.

Univariate association at baseline between different outcomes and variables considered as potential confounders in the association between intervention assignment and outcomes are presented in Table 6. This table shows that most covariates did not reach statistical significance when evaluating the relationship between covariates and outcome. Significant associations were found between the outcomes and gender, where women seem to talk significantly more than men about different HIV prevention topics. For example, the odds of talking about getting HIV testing 'at least few times a week' compared to those who talk 'never' was 3.7 ($p<0.001$) times higher in women than men. The same was true for conversations about HIV transmission, cleaning needles with bleach and condom use. There was no significant difference in frequency of conversation about the danger of sharing needles with other people between men and women. Moreover, other races when compared with African Americans talk less about HIV prevention topics, in particular when comparing those who talk 'at least few times a week' versus those who 'never' talk; although one must keep in mind that the majority (85%) of the sample were African Americans.

Figure 3 shows the cumulative probabilities of the frequency of conversation about different HIV prevention topics among IDUs stratified by intervention groups. The figure shows that the chosen model perfectly fits the data.

In the final model the interaction between intervention assignment and time was significant for each of the five outcomes, which suggested that the change in the odds of talking about HIV prevention topics over time differed across the intervention groups. Thus, we ran stratified analysis by intervention

assignment (Table 7). There was an increase in the frequency of communication between IDUs about the HIV prevention topic among the controls and intervention groups at the 6-month visit. For subsequent visits the effect of the intervention decreased. For example, among controls the odds of talking about HIV transmission 'at least few times a week' was 69% ($p<0.05$) lower at the 18-month visit compared to the baseline. In the intervention group we observed a significant increase in talking 'at least a few times a week' comparing the 6-month visit to the baseline for all the HIV prevention topics. By the 18-month visit the conversation about getting HIV testing and HIV transmission remained higher compared to baseline but not statistically significant with the odds ratio of talking 'at least a few times a week' versus 'never' being 1.51 (95% confidence interval (CI) = 0.72 - 3.15) and 1.74 (95% CI = 0.88 - 3.49), respectively.

The frequency of the conversation about cleaning needles with bleach followed a similar pattern the to conversation about HIV transmission and getting HIV testing. Within the intervention group, the frequency of conversation about cleaning needles was higher at the 6-month visit for those who talk 'at least once a month' compared to 'never,' and it remained higher by the 18-month visit, although not significantly higher compared to the baseline. Whereas talking about needle cleaning with bleach 'at least few times a week' dropped by 21% at the 18-month visit compared to baseline (this was not statistically significant). Conversation about needle sharing 'at least once a month' remained significantly higher comparing the 18-month visit to the baseline visit (odds ratio (OR) = 2.00; 95% CI = 1.01 - 3.95), although it decreased overall from the 6-month visit (OR = 5.97; 95% CI = 2.54 - 14.01). The discussion about needle sharing 'at least a few

times a week' decreased by 15% by the 18-month visit (statistically not significant).

Only the frequency of conversation about condom use, even though it still decreased in magnitude over time, remained significantly higher when comparing the 18-month visit to the baseline visit. The odds of talking 'at least once a month' were 2.34 (95% CI = 1.23 - 4.44) times the odds of talking 'never' comparing the 18-month visit to the baseline. The odds of talking 'at least a few times a week' were 2.31 (95% CI = 1.17 - 4.54) times the odds of talking 'never' comparing the 18-month visit to the baseline visit.

Figure 4 represents the cumulative probabilities of different outcomes over time stratified by the intervention assignment. Overall we observed that the probability of talking more than 'never' about any of the HIV prevention topics decreased over time among the Index participants in the control group. In the intervention group the probability of talking more than 'never' about HIV testing and HIV transmission increased over time and it remained slightly high at the 18-month visit compared to the baseline visit. The probability of talking about cleaning needles with bleach and danger of sharing needles with other people initially increased at the 6-month visit and decreased by the 12-month visit, continuing to decrease at the 18-month visit to a probability comparable to the baseline. Among the HIV prevention topics, only the probability of talking about condom use remained higher in the intervention group at 18-months compared to the baseline.

Table 8 shows the difference in frequency of conversation between the intervention and control group for each visit. A significantly higher frequency of conversation was observed for most of the HIV prevention topics, with the

exception of HIV testing, comparing intervention to controls at the 6-month visit. At the 6-month visit the odds of talking 'at least a few times a week' compared to 'never' about HIV testing (OR = 1.86; 95% CI = 0.87 - 3.95), HIV transmission (OR = 3.22; 95% CI = 1.39 - 7.46), needle cleaning (OR = 4.35; 95% CI = 1.88 - 10.07), needle sharing (OR = 4.35; 95% CI = 1.80 - 10.54), and condom use (OR = 2.25; 95% CI = 1.05 - 4.84) were higher in the intervention group compared to the control group. These differences decreased over time and by the 18-month visit the differences that remained significant were for the danger of needle sharing (OR = 3.21; 95% CI = 1.45 - 7.14) and condom use (OR = 2.81; 95% CI = 1.28 - 6.17)).

# Chapter 6: Discussion and Conclusion

This study examined the effect of a peer-based, personal network-focused, educational intervention on the frequency of conversation about HIV prevention topics among IDUs in Baltimore, Maryland. The objective of the study was to assess the differences in the frequency of conversation between the control and intervention groups over time. In addition to the difference in frequency of conversation, the sustainability of talking about HIV prevention topics over time was examined as well as the type of topics that IDUs persistently talked about. Understanding how the frequency of communication about HIV prevention changes over time is important in helping design, evaluate and improve peer-based interventions among IDUs.

There are a few overall observations that can be drawn from the analysis. First, peer-based education had a significant positive effect on the frequency of conversation about any of the HIV prevention topics examined in this study. Secondly, over time the effect of the intervention decayed and the frequency of conversation about any of the topics decreased. Finally, Index participants discussed certain topics with their injecting partners more often than others and for some topics IDUs retained a significantly high level of conversation by the 18-month visit compared to the baseline.

Within the intervention group the frequency of conversation increased significantly for all of the HIV prevention topics at the 6-month visit. By the 18-month visit conversation topics that remained significantly more talked about in an intervention group were danger of needle sharing and condom use. Similarly,

comparing the intervention to the control group during different visits we observed that at the 6-month visit those in the intervention group talked significantly more about all HIV prevention topics with the exception of HIV testing. By the 18-month visit the differences that remained statistically significant between the intervention and control groups were for the danger of needle sharing and condom use. Thus, Index participants seem to be more comfortable with some conversation topics about HIV prevention and less comfortable with others.

In particular the conversation about HIV testing and HIV transmission did not persist among IDUs, which could be due to high stigma being associated with HIV and potential discrimination (from society and family) that one might experience if tested HIV positive. A study of 25 HIV-positive male IDUs in Thai Nguyen, Vietnam suggested that individuals whose HIV status was revealed to the community experienced a negative shift in separation and discrimination from the community (Rudolph *et al.*, 2012). Research by Parsons *et al.* (2004) revealed several adverse effects for HIV-positive IDUs whose status was revealed in the community, such as rejection, loss of intimacy and material resources. In addition, some studies have found that, for example, sex partners have a violent reaction to HIV-related communications (El-Bassel, *et al.*, 2000).

Sharing needles and use of dirty needles is prevalent among IDUs and it may be hard to make the right choices, even if trained at safe injecting, when one really needs a 'fix'. Thus, the decrease in frequency of conversation about those topics could be due to the 'guilt feeling' among Index participants of not consistently practicing what they are encouraging others to do.

Finally, longitudinal persistence of the high frequency of conversation

about condom use in the intervention group (significantly more frequent conversation compared to controls even at the 18-month visit) could be due to the wide acceptance of condom use. In addition, talking about use of condoms does not necessarily imply prevention of HIV transmission; it could mean prevention of other less stigmatizing sexually transmitted infections (STIs) or prevention of pregnancy.

Nevertheless, as a result of an intervention the frequency of conversation increased by the second visit for most of the HIV prevention topics with the exception of conversation about HIV testing. Thus, peer-based educational intervention resulted in an increased conversation about HIV prevention topics among IDUs, but a decrease was observed over time and for most of the conversation topics, there was no statistically significant difference between intervention and control group at the 18-month visit. The fact that the frequency of conversation increased initially and decreased as the study progressed suggests a need to constantly reinforce positive behavior among IDUs, which could potentially be achieved through booster sessions.

Booster sessions showed association with reduction in risky sex and injecting behaviors among IDUs. A randomized controlled trial evaluating the effect of a peer-based behavioral intervention among IDUs in Thai Nguyen, Vietnam reported that those who attended booster sessions and/or support person sessions were more likely to decrease sexual risk behavior (Go *et al.*, 2013). Another study among IDUs in Haryana, India examined the association between the level of exposure to peer-based education sessions and needle sharing practices. These studies showed that the proportion of IDUs who shared needles substantially decreased among those who attended three or more peer-

based education sessions (49% vs 11%, $p<0.001$) in a month (Jain *et al.*, 2014). Thus, the studies suggest that repeated exposure to peer-based educational sessions is more effective in reducing risk behavior among IDUs than one time exposure. HIV prevention programs have to constantly reinforce the reduction in the risk behavior among IDUs by promoting repeated, monthly interaction with peer health educators.

One of the limitations of this analysis is the potential contamination of the information received in the control group by information from the intervention group. Increases in the frequency of conversation about HIV prevention topics at the 6-month visit among controls could have been due to spillover of the information from the intervention group. Further, variables that were considered as potential confounders were treated as fixed and their baseline values were used for exploratory data analysis. Using time-varying covariates should be considered because some of the variables, such as daily injecting in the past 6 months, are subject to change over time. In addition, other confounders should have been considered, such as HIV status. In particular for an association between the intervention and frequency of conversation about cleaning needles with bleach, reported needle cleaning within the prior 6 months should have been taken into account. Also, when assessing the association between the intervention and frequency of conversation about the danger of sharing needles with other people, reported needle sharing within the prior 6 months should have been examined. A sample of 227 participants is fairly small, thus we would need a larger study to more effectively investigate this issue. In addition, participants were recruited through street-based outreach, word of mouth and posted advertisements throughout the community, which may not result in a

representative study sample of the target population. Thus, it might be challenging to generalize the results of the study to the wider IDU population of the United States and populations outside of the United States.

In conclusion, it is challenging to develop behavioral interventions among the most-at-risk populations and assure sustainability of the reduced risk behavior in these populations. We have shown that intervention has a positive impact on the conversation about HIV prevention topics among IDUs, but sustainability past 6 months was challenging for most of the conversation topics. Nevertheless, increase in the conversation is possible for all of the topics since we observed a significant increase by the 6-month visit for each of the HIV prevention topics. Based on this finding and since conversation plays an important role in the success of peer-based interventions, it would be important to explore the options of using booster sessions to continuously encourage conversation among IDUs. For example, IDUs might just get bored talking about the same issues over and over again, and booster sessions could introduce new ways of bringing up HIV prevention in conversation. Finally, exploring ways in which conversation about stigmatized topics, such as HIV testing and transmission could occur in a more effective way such that individuals do not feel accused or uncomfortable could provide more effective ways to convey the HIV prevention message among IDUs.

## Tables, and Figures

**Figure 1.** Flowchart of Index participants in the STEP into Action randomized trial, Baltimore, Maryland

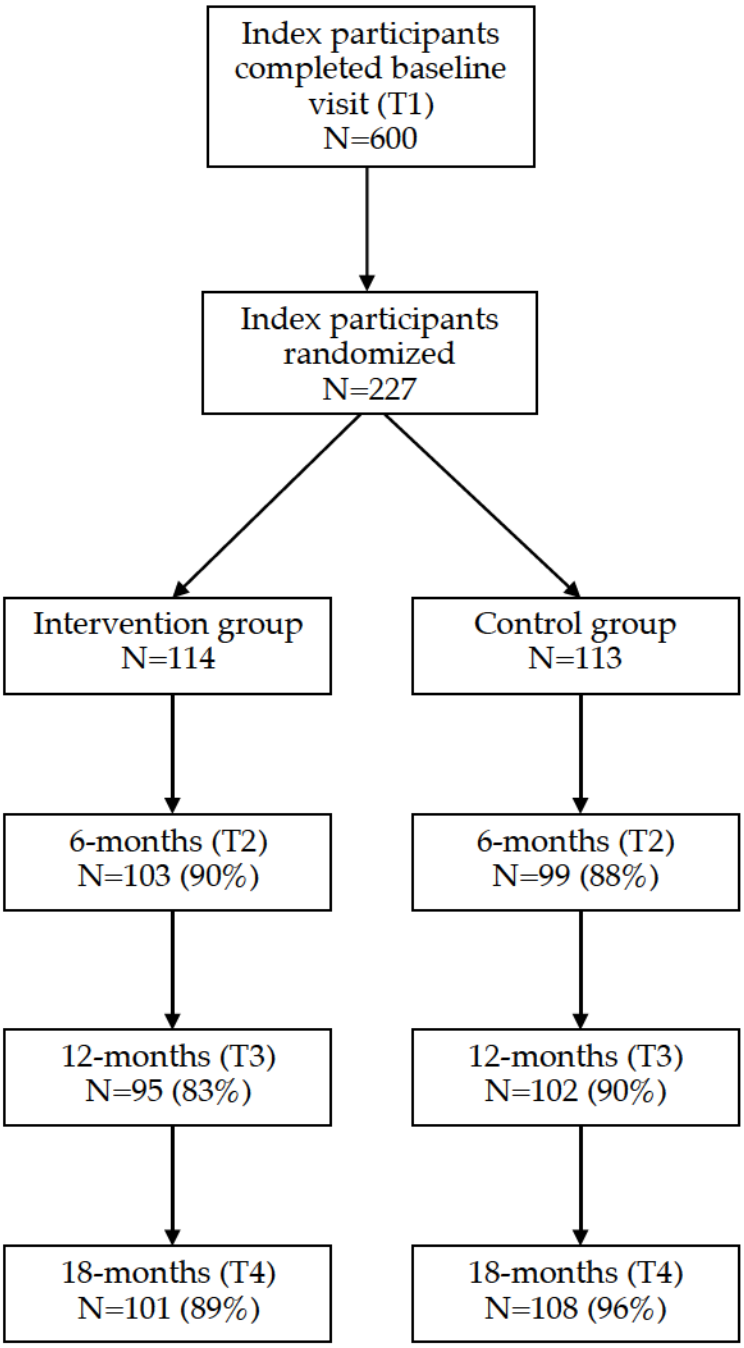


**Table 1.** Baseline sample characteristics of randomized Index participants, n (%).

| | **Intervention group (n=114)** | **Control group (n=113)** |
|---|---|---|
| Male | 63 (55) | 61 (54) |
| Age | 43.9 (7.8) | 43.0 (7.4) |
| African American | 96 (84) | 98 (87) |
| **Education** | | |
| Grade 1-11th | 70 (61) | 55 (49) |
| 12th grade/High school diploma | 33 (29) | 41 (36) |
| Some college/college degree | 11 (10) | 17 (15) |
| Homeless in the past 6 months | 43 (38) | 42 (37) |
| Prison in the past 6 months | 27 (24) | 31 (27) |
| Unemployed in the past 6 months | 106 (93) | 101 (89) |
| Daily injection in past 6 months | 58 (51) | 51 (46) |
| Using an unclean needle | 45 (40) | 49 (43) |
| Using an unclean cotton or cooker | 74 (65) | 73 (65) |
| Have main sexual partner | 75 (66) | 75 (66) |
| Two or more sex partners | 37 (33) | 41 (36) |
| Exchange sex in past 90 days for food, shelter, drugs or money | 20 (22) out of 92* | 24 (25) out of 96* |

*Among those who reported having sex in past 90 days.

**Figure 2.** Distribution of the reported frequency of conversation about different HIV prevention topics among IDUs at baseline.

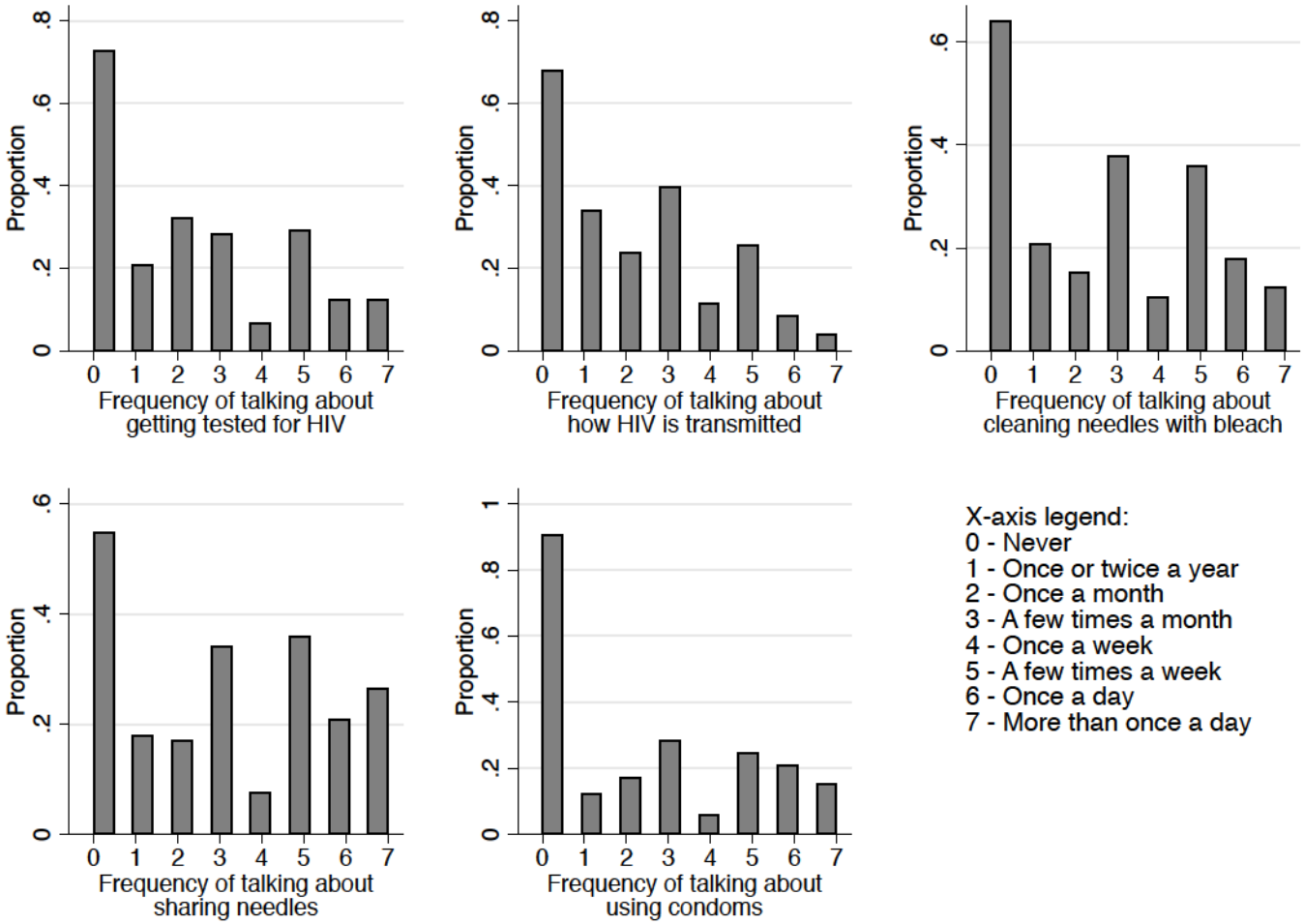


**Table 2.** Time-specific unadjusted odds ratios for the risk of missing the outcome based on the baseline characteristics.

| | Time (T2) OR (95% CI) | Time (T3) OR (95% CI) | Time (T4) OR (95% CI) |
|---|---|---|---|
| Intervention | 0.61 (0.24 - 1.56) | 1.08 (0.46 - 2.55) | 1.70 (0.92 - 3.14) |
| Age | 1.00 (0.94 - 1.06) | 1.00 (0.94 - 1.06) | 1.01 (0.97 - 1.05) |
| Female vs. male | 0.59 (0.22 - 1.54) | 0.92 (0.39 - 2.16) | 0.82 (0.45 - 1.52) |
| Others vs. African American | 0.35 (0.04 - 2.71) | 0.70 (0.15 - 3.18) | 0.73 (0.28 - 1.92) |
| **Education** | | | |
| 12th grade / high school diploma vs. 1-11th grade | 0.69 (0.25 - 1.89) | 0.76 (0.27 - 2.10) | 0.75 (0.38 - 1.51) |
| Some college / college degree vs. 1-11th grade | None missing | 1.83 (0.59 - 5.70) | 1.18 (0.48 - 2.89) |
| Homelessness in past 6 months | 1.84 (0.73 - 4.66) | 1.84 (0.78 - 4.33) | 0.97 (0.52 - 1.83) |
| Exchanging sex for money, food drugs or shelter in past 90 days | 0.67 (0.18 - 2.46) | 0.54 (0.15 - 1.95) | 0.45 (0.18 - 1.11) |
| Prison in past 6 months | 0.16 (0.02 - 1.23) | 0.46 (0.13 - 1.62) | 0.62 (0.28 - 1.34) |
| Daily injecting in past 6 months | 0.94 (0.37 - 2.39) | 0.87 (0.36 - 2.10) | 0.94 (0.51 - 1.73) |

CI: confidence interval; OR: odds ratio; T2: 6-month visit; T3: 12-month visit; T4: 18-month visit

**Table 3.** Unadjusted odds ratios for the risk of missing the response based on the outcome in the prior visits.

| Time (T1) | Time (T2) OR (95% CI) | Time (T3) OR (95% CI) | Time (T4) OR (95% CI) |
|---|---|---|---|
| **HIV testing** | | | |
| At least once a month vs. Never | 0.68 (0.30 - 1.52) | 0.96 (0.46 - 1.99) | 1.05 (0.55 - 2.02) |
| At least few times a week vs. Never | 1.10 (0.50 - 2.40) | 1.18 (0.56 - 2.50) | 1.28 (0.64 - 2.54) |
| **HIV transmission** | | | |
| At least once a month vs. Never | 0.89 (0.44 - 1.81) | 1.52 (0.79 - 2.95) | 1.13 (0.61 - 2.09) |
| At least few times a week vs. Never | 0.50 (0.18 - 1.41) | 0.62 (0.23 - 1.64) | 1.17 (0.54 - 2.52) |
| **Needle cleaning** | | | |
| At least once a month vs. Never | 0.87 (0.40 - 1.87) | 1.59 (0.77 - 3.29) | 1.05 (0.52 - 2.10) |
| At least few times a week vs. Never | 0.55 (0.24 - 1.25) | 1.02 (0.48 - 2.19) | 1.74 (0.90 - 3.36) |
| **Needle sharing** | | | |
| At least once a month vs. Never | 0.81 (0.36 - 1.81) | 0.73 (0.32 - 1.66) | 0.44 (0.20 - 0.94)* |
| At least few times a week vs. Never | 0.53 (0.24 - 1.16) | 1.08 (0.53 - 2.18) | 0.99 (0.53 - 1.87) |
| **Condom use** | | | |
| At least once a month vs. Never | 0.31 (0.12 - 0.81)* | 0.42 (0.18 - 0.99)* | 0.75 (0.37 - 1.53) |
| At least few times a week vs. Never | 0.36 (0.15 - 0.84)* | 0.67 (0.33 - 1.39) | 1.09 (0.57 - 2.08) |

*P<0.05; **P<0.01; ***P<0.001; CI: confidence interval; OR: odds ratio; T1: baseline visits; T2: 6-month visit; T3: 12-month visit; T4: 18-month visit

**Table 3.** (Continued)

| Time (T2) | Time (T3) OR (95% CI) | Time (T4) OR (95% CI) | Time (T3) | Time (T4) OR (95% CI) |
|---|---|---|---|---|
| **HIV testing** | | | **HIV testing** | |
| At least once a month vs. Never | 1.27 (0.39 - 4.12) | 1.49 (0.60 - 3.68) | At least once a month vs. Never | 1.28 (0.55 - 3.03) |
| At least few times a week vs. Never | 3.02 (1.00 - 9.16) | 3.56 (1.46 - 8.68)** | At least few times a week vs. Never | 1.77 (0.64 - 4.85) |
| **HIV transmission** | | | **HIV transmission** | |
| At least once a month vs. Never | 0.79 (0.26 - 2.37) | 1.52 (0.64 - 3.61) | At least once a month vs. Never | 0.60 (0.26 - 1.38) |
| At least few times a week vs. Never | 2.03 (0.68 - 6.04) | 2.11 (0.83 - 5.42) | At least few times a week vs. Never | 0.88 (0.30 - 2.55) |
| **Needle cleaning** | | | **Needle cleaning** | |
| At least once a month vs. Never | 2.01 (0.61 - 6.64) | 2.24 (0.91 - 5.48) | At least once a month vs. Never | 0.74 (0.29 - 1.84) |
| At least few times a week vs. Never | 2.56 (0.75 - 8.76) | 2.16 (0.83 - 5.62) | At least few times a week vs. Never | 2.04 (0.81 - 5.15) |
| **Needle sharing** | | | **Needle sharing** | |
| At least once a month vs. Never | 1.62 (0.41 - 6.40) | 1.54 (0.58 - 4.11) | At least once a month vs. Never | 1.06 (0.40 - 2.78) |
| At least few times a week vs. Never | 2.48 (0.67 - 9.27) | 1.69 (0.64 - 3.15) | At least few times a week vs. Never | 1.67 (0.65 - 4.25) |
| **Condom use** | | | **Condom use** | |
| At least once a month vs. Never | 0.53 (0.15 - 1.87) | 0.89 (0.34 - 2.33) | At least once a month vs. Never | 0.76 (0.30 - 1.95) |
| At least few times a week vs. Never | 1.74 (0.62 - 4.88) | 2.45 (1.02 - 5.88)* | At least few times a week vs. Never | 1.29 (0.53 - 3.13) |

*P<0.05; **P<0.01; ***P<0.001; CI: confidence interval; OR: odds ratio; T1: baseline visits; T2: 6-month visit; T3: 12-month visit; T4: 18-month visit

**Table 4.** Correlation of the responses over time within individual.

| | Overall | | Between individuals | | Within individual |
|---|---|---|---|---|---|
| **HIV testing** | Number | Percent | Number | Percent | Percent |
| Never | 299 | 40.74 | 153 | 67.40 | 59.59 |
| At least once a month | 257 | 35.01 | 147 | 64.76 | 53.17 |
| At least few times a week | 178 | 24.25 | 111 | 48.90 | 51.95 |
| **HIV transmission** | | | | | |
| Never | 289 | 39.37 | 152 | 66.96 | 59.76 |
| At least once a month | 309 | 42.10 | 162 | 71.37 | 58.44 |
| At least few times a week | 136 | 18.53 | 90 | 39.65 | 46.11 |
| **Needle cleaning** | | | | | |
| Never | 274 | 37.33 | 137 | 60.35 | 61.44 |
| At least once a month | 265 | 36.10 | 150 | 66.08 | 54.44 |
| At least few times a week | 195 | 26.57 | 111 | 48.90 | 55.11 |
| **Needle sharing** | | | | | |
| Never | 226 | 30.79 | 127 | 55.95 | 55.84 |
| At least once a month | 243 | 33.11 | 139 | 61.23 | 51.98 |
| At least few times a week | 265 | 36.10 | 147 | 64.76 | 57.03 |
| **Condom use** | | | | | |
| Never | 291 | 39.65 | 154 | 67.84 | 61.31 |
| At least once a month | 220 | 29.97 | 128 | 56.39 | 48.83 |
| At least few times a week | 223 | 30.38 | 126 | 55.51 | 55.62 |

**Table 5.** Time-specific unadjusted odds ratios for the risk of being in the intervention group based on the baseline characteristics of the Index participants.

| | Time (T1) OR (95% CI) | Time (T2) OR (95% CI) | Time (T3) OR (95% CI) | Time (T4) OR (95% CI) |
|---|---|---|---|---|
| Age | 1.02 (0.98 - 1.05) | 1.01 (0.97 - 1.05) | 1.02 (0.98 - 1.06) | 1.02 (0.98 - 1.06) |
| Female vs. male | 0.95 (0.56 - 1.60) | 0.93 (0.53 - 1.61) | 1.06 (0.60 - 1.85) | 1.01 (0.59 - 1.74) |
| Others vs. African American | 1.23 (0.58 - 2.57) | 1.52 (0.65 - 3.56) | 1.08 (0.45 - 2.63) | 0.99 (0.44 - 2.23) |
| **Education** | | | | |
| 12th grade / high school diploma vs. 1-11th grade | 0.63 (0.35 - 1.13) | 0.67 (0.36 - 1.23) | 0.85 (0.46 - 1.58) | 0.73 (0.40 - 1.34) |
| Some college / college degree vs. 1-11th grade | 0.51 (0.22 - 1.17) | 0.50 (0.20 - 1.25) | 0.64 (0.27 - 1.56) | 0.58 (0.25 - 1.35) |
| Homelessness in past 6 months | 1.02 (0.60 - 1.75) | 1.02 (0.58 - 1.81) | 0.98 (0.55 - 1.75) | 1.03 (0.59 - 1.80) |
| Exchanging sex for money, food drugs or shelter in past 90 days | 0.83 (0.42 - 1.64) | 0.93 (0.44 - 1.96) | 0.89 (0.42 - 1.89) | 0.85 (0.41 - 1.74) |
| Prison in past 6 months | 0.82 (0.45 - 1.49) | 0.85 (0.44 - 1.64) | 0.77 (0.39 - 1.51) | 0.75 (0.39 - 1.43) |
| Daily injecting in past 6 months | 1.24 (0.74 - 2.09) | 1.31 (0.75 - 2.28) | 1.27 (0.72 - 2.23) | 1.16 (0.67 - 2.00) |

CI: confidence interval; OR: odds ratio; T1: baseline visits; T2: 6-month visit; T3: 12-month visit; T4: 18-month visit

**Table 6.** Unadjusted odds ratios for the risk of increased frequency of conversation about HIV prevention topics at baseline based on the baseline Index participants' characteristics.

| | Age OR (95% CI) | Female vs. male OR (95% CI) | Others versus African American OR (95% CI) | 12th grade/high school diploma versus 1-11th grade OR (95% CI) |
|---|---|---|---|---|
| **HIV testing** | | | | |
| At least once a month vs. Never | 1.03 (0.99 - 1.08) | 1.74 (0.93 - 3.25) | 0.44 (0.19 - 1.07) | 1.14 (0.57 - 2.27) |
| At least few times a week vs. Never | 1.10 (0.96 - 1.05) | 3.70 (1.86 - 7.35)*** | 0.19 (0.06 - 0.68)* | 0.87 (0.43 - 1.75) |
| **HIV transmission** | | | | |
| At least once a month vs. Never | 1.03 (0.99 - 1.07) | 1.59 (0.89 - 2.87) | 0.39 (0.17 - 0.93)* | 0.97 (0.51 - 1.85) |
| At least few times a week vs. Never | 1.07 (1.01 - 1.12) | 2.21 (1.06 - 4.62)* | 0.09 (0.01 - 0.69)* | 1.08 (0.49 - 2.37) |
| **Needle cleaning** | | | | |
| At least once a month vs. Never | 1.02 (0.97 - 1.06) | 1.22 (0.64 - 2.35) | 0.79 (0.34 - 1.80) | 1.35 (0.67 - 2.76) |
| At least few times a week vs. Never | 1.01 (0.97 - 1.06) | 3.07 (1.60 - 5.87)** | 0.24 (0.08 - 0.75)* | 1.44 (0.73 - 2.85) |
| **Needle sharing** | | | | |
| At least once a month vs. Never | 1.00 (0.95 - 1.04) | 1.94 (0.97 - 3.88) | 0.65 (0.26 - 1.59) | 1.64 (0.76 - 3.53) |
| At least few times a week vs. Never | 1.01 (0.97 - 1.06) | 2.91 (1.53 - 5.51) | 0.38 (0.15 - 0.59)* | 1.37 (0.70 - 2.71) |
| **Condom use** | | | | |
| At least once a month vs. Never | 1.01 (0.97 - 1.06) | 1.38 (0.71 -2.68) | 0.36 (0.13 - 1.01) | 0.85 (0.41 - 1.78) |
| At least few times a week vs. Never | 1.01 (0.97 - 1.05) | 2.69 (1.43 - 5.08)** | 0.24 (0.08 - 0.72)* | 0.83 (0.42 - 1.63) |

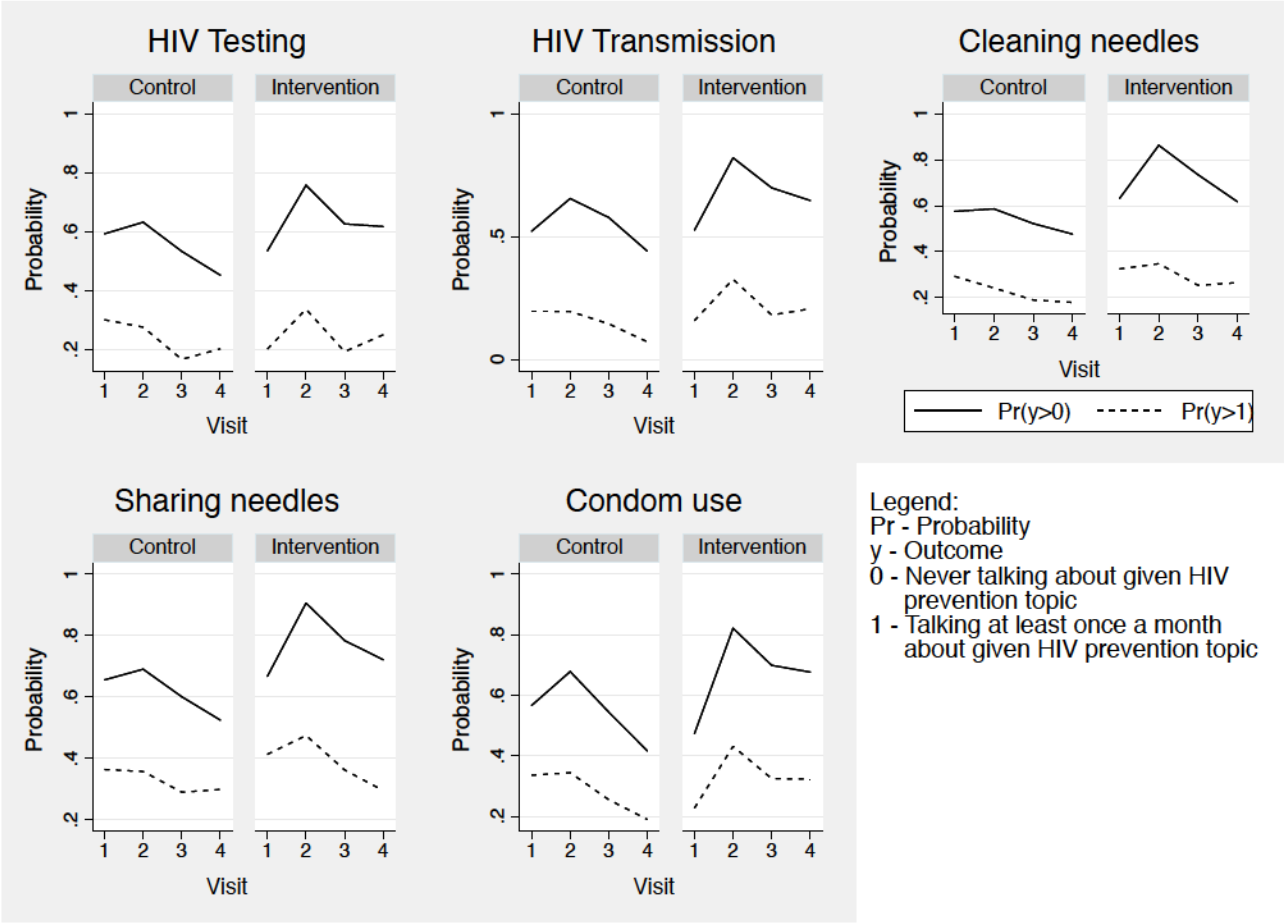
*P<0.05; **P<0.01; ***P<0.001; CI: confidence interval; OR: odds ratio

**Table 6.** (Continued)

| | Some college / college degree versus 1-11th grade OR (95% CI) | Homelessness in past 6 months OR (95% CI) | Exchanging sex for money, food, drugs or shelter in past 90 days OR (95% CI) | Prison in past 6 months OR (95% CI) | Daily injecting in past 6 months OR (95% CI) |
|---|---|---|---|---|---|
| **HIV testing** | | | | | |
| At least once a month vs. Never | 1.71 (0.72 - 4.08) | 0.58 (0.30 - 1.11) | 0.33 (0.13 - 0.83)* | 0.65 (0.32 - 1.32) | 0.79 (0.43 - 1.46) |
| At least few times a week vs. Never | 0.11 (0.01 - 0.89)* | 1.15 (0.60 - 2.23) | 1.02 (0.46 - 2.24) | 0.79 (0.37 - 1.65) | 0.79 (0.41 - 1.52) |
| **HIV transmission** | | | | | |
| At least once a month vs. Never | 1.72 (0.70 - 4.20) | 0.63 (0.34 - 1.17) | 0.92 (0.44 - 1.93) | 0.84 (0.44 - 1.62) | 1.17 (0.66 - 2.10) |
| At least few times a week vs. Never | 1.01 (0.29 - 3.50) | 1.08 (0.52 - 2.24) | 0.87 (0.33 - 2.29) | 0.53 (0.21 - 1.32) | 1.40 (0.67 - 2.93) |
| **Needle cleaning** | | | | | |
| At least once a month vs. Never | 1.29 (0.52 - 3.22) | 0.96 (0.50 - 1.86) | 0.62 (0.27 - 1.45) | 0.99 (0.48 - 2.05) | 1.15 (0.62 - 2.18) |
| At least few times a week vs. Never | 0.41 (0.12 - 1.36) | 1.15 (0.61 - 2.19) | 1.20 (0.54 - 2.67) | 1.00 (0.49 - 2.06) | 1.23 (0.66 - 2.31) |
| **Needle sharing** | | | | | |
| At least once a month vs. Never | 2.14 (0.83 - 5.52) | 0.45 (0.22 - 0.93)* | 0.98 (0.41 - 2.30) | 0.62 (0.28 - 1.36) | 0.86 (0.44 - 1.67) |
| At least few times a week vs. Never | 0.45 (0.14 - 1.42) | 0.72 (0.39 - 1.34) | 0.81 (0.36 - 1.82) | 0.78 (0.39 - 1.55) | 0.87 (0.47 - 1.60) |
| **Condom use** | | | | | |
| At least once a month vs. Never | 1.18 (0.46 - 3.02) | 0.71 (0.35 - 1.41) | 0.91 (0.40 - 2.09) | 0.78 (0.35 - 1.72) | 0.79 (0.41 - 1.52) |
| At least few times a week vs. Never | 0.39 (0.12 - 1.26) | 0.98 (0.52 - 1.85) | 0.94 (0.42 - 2.12) | 1.38 (0.70 - 2.74) | 0.60 (0.32 - 1.12) |

*P<0.05; **P<0.01; ***P<0.001; CI: confidence interval; OR: odds ratio

**Figure 3.** Cumulative probability of talking about different HIV prevention topics stratified by intervention group.




The lines that represent the raw data proportions are not apparent on the graph because the probabilities estimated by the model perfectly overlap them.

**Table 7.** Odds ratios for the risk of increased frequency of conversation about HIV prevention topics over time stratified by intervention groups.

| | Time | Control OR (95% CI) | Intervention OR (95% CI) |
|---|---|---|---|
| **HIV testing** | | | |
| At least once a month vs. Never | T2 vs. T1 | 1.35 (0.72 - 2.52) | 2.43 (1.29 - 4.55) |
| | T3 vs. T1 | 1.10 (0.62 - 1.94) | 1.61 (0.91 - 2.90) |
| | T4 vs. T1 | 0.64 (0.34 - 1.20) | 1.34 (0.67 - 2.68) |
| At least few times a week vs. Never | T2 vs. T1 | 1.01 (0.58 - 1.77) | 3.21 (1.76 - 5.84)*** |
| | T3 vs. T1 | 0.48 (0.25 - 0.93)* | 1.19 (0.62 - 2.28) |
| | T4 vs. T1 | 0.50 (0.27 - 0.92)* | 1.51 (0.72 - 3.15) |
| **HIV transmission** | | | |
| At least once a month vs. Never | T2 vs. T1 | 1.95 (1.13 - 3.35)* | 3.55 (1.82 - 6.92)*** |
| | T3 vs. T1 | 1.50 (0.87 - 2.59) | 2.21 (1.22 - 4.01)** |
| | T4 vs. T1 | 0.96 (0.52 - 1.77) | 1.61 (0.85 - 3.04) |
| At least few times a week vs. Never | T2 vs. T1 | 1.39 (0.69 - 2.79) | 5.47 (2.62- 11.40)*** |
| | T3 vs. T1 | 0.84 (0.43 - 1.64) | 1.80 (0.91 - 3.56) |
| | T4 vs. T1 | 0.31 (0.12 - 0.83)* | 1.74 (0.88 - 3.49) |
| **Needle cleaning** | | | |
| At least once a month vs. Never | T2 vs. T1 | 1.25 (0.70 - 2.22) | 4.52 (2.21 - 9.27)*** |
| | T3 vs. T1 | 1.05 (0.55 - 2.01) | 2.18 (1.10 - 4.31)* |
| | T4 vs. T1 | 0.85 (0.45 - 1.62) | 1.11 (0.58 - 2.10) |
| At least few times a week vs. Never | T2 vs. T1 | 0.85 (0.51 - 1.41) | 2.88 (1.39 - 5.98)** |
| | T3 vs. T1 | 0.58 (0.33 - 0.99)* | 1.08 (0.56 - 2.10) |
| | T4 vs. T1 | 0.50 (0.27 - 0.92)* | 0.79 (0.41 - 1.49) |

*P<0.05; **P<0.01; ***P<0.001; CI: confidence interval; OR: odds ratio; T1: baseline visits; T2: 6-month visit; T3: 12-month visit; T4: 18-month visit

**Table 7.** (Continued)

| | Time | Control OR (95% CI) | Intervention OR (95% CI) |
|---|---|---|---|
| **Needle sharing** | | | |
| At least once a month vs. Never | T2 vs. T1 | 1.27 (0.69 - 2.35) | 5.97 (2.54 - 14.01)*** |
| | T3 vs. T1 | 0.92 (0.46 - 1.83) | 2.55 (1.24 - 5.22)* |
| | T4 vs. T1 | 0.56 (0.27 - 1.15) | 2.00 (1.01 - 3.95)* |
| At least few times a week vs. Never | T2 vs. T1 | 1.09 (0.63 - 1.89) | 4.04 (1.81 - 9.02)** |
| | T3 vs. T1 | 0.69 (0.38 - 1.24) | 1.35 (0.69 - 2.65) |
| | T4 vs. T1 | 0.59 (0.32 - 1.12) | 0.85 (0.43 - 1.70) |
| **Condom use** | | | |
| At least once a month vs. Never | T2 vs. T1 | 1.95 (1.02 - 3.72)* | 4.66 (2.48 - 8.76)*** |
| | T3 vs. T1 | 1.20 (0.60 - 2.38) | 2.66 (1.44 - 4.89)** |
| | T4 vs. T1 | 0.73 (0.35 - 1.51) | 2.34 (1.23 - 4.44)** |
| At least few times a week vs. Never | T2 vs. T1 | 1.38 (0.83 - 2.31) | 5.57 (3.01 - 10.30)*** |
| | T3 vs. T1 | 0.72 (0.39 - 1.34) | 2.49 (1.37 - 4.52)** |
| | T4 vs. T1 | 0.42 (0.23 - 0.77)** | 2.31 (1.17 - 4.54)* |

*P<0.05; **P<0.01; ***P<0.001; CI: confidence interval; OR: odds ratio; T1: baseline visits; T2: 6-month visit; T3: 12-month visit; T4: 18-month visit

**Figure 4.** Change in the probability of the frequency of talking about different HIV prevention topics over time stratified by intervention groups.

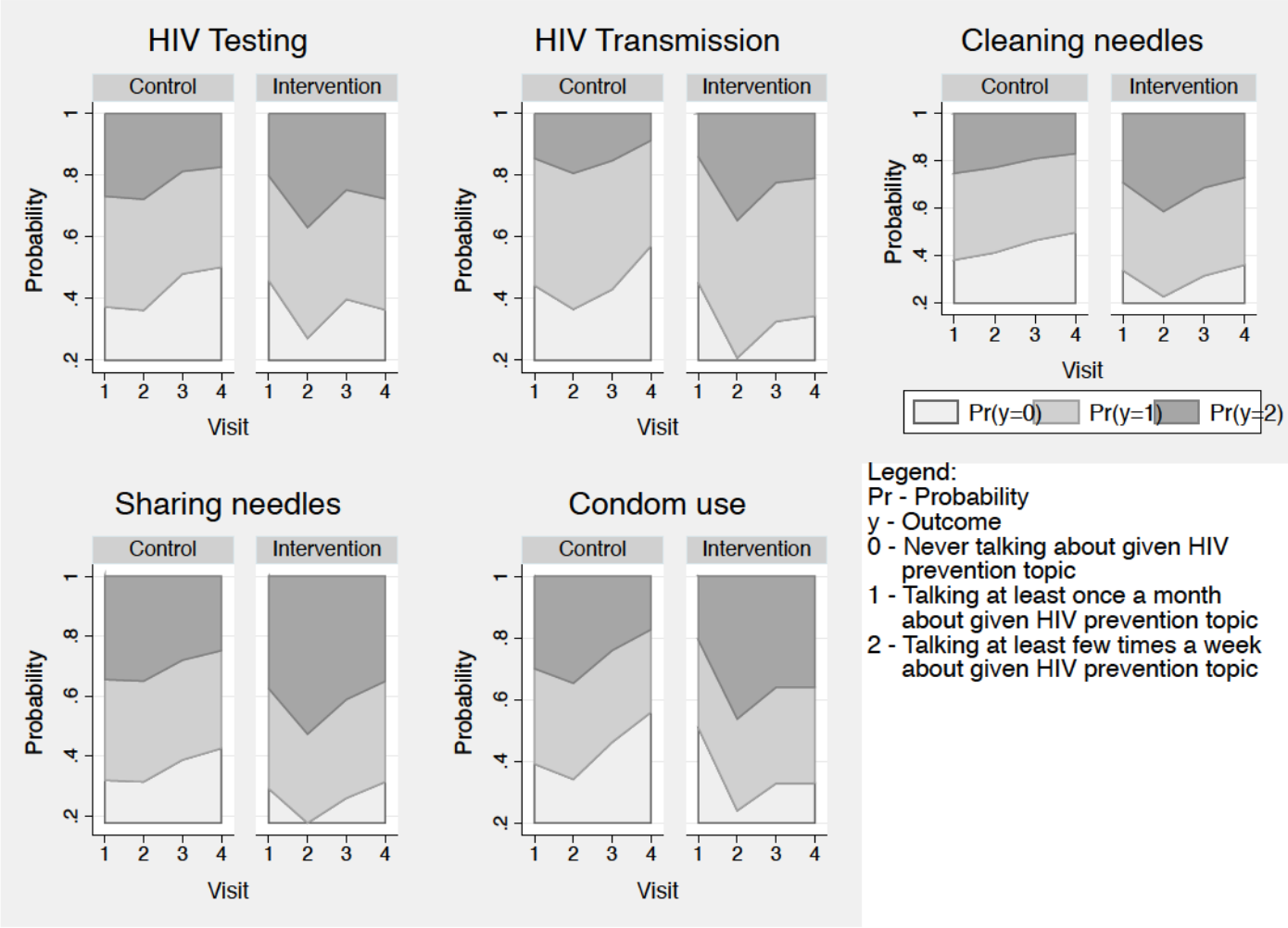


**Table 8.** Time-specific unadjusted odds ratios for the risk of increased frequency of conversation about HIV prevention topics comparing intervention to control group.

| | Time (T1) OR (95% CI) | Time (T2) OR (95% CI) | Time (T3) OR (95% CI) | Time (T4) OR (95% CI) |
|---|---|---|---|---|
| **HIV testing** | | | | |
| At least once a month vs. Never | 1.00 (0.54 - 1.84) | 1.80 (0.88 - 3.66) | 1.48 (0.76 - 2.87) | 2.11 (0.99 - 4.48) |
| At least few times a week vs. Never | 0.59 (0.30 - 1.14) | 1.86 (0.87 - 3.95) | 1.45 (0.62 - 3.37) | 1.77 (0.77 - 4.05) |
| **HIV transmission** | | | | |
| At least once a month vs. Never | 1.14 (0.63 - 2.03) | 2.07 (1.00 - 4.31) | 1.68 (0.86 - 3.26) | 1.90 (0.94 - 3.83) |
| At least few times a week vs. Never | 0.82 (0.39 - 1.69) | 3.22 (1.39 - 7.46)** | 1.75 (0.71 - 4.31) | 4.57 (1.56 - 13.43)** |
| **Needle cleaning** | | | | |
| At least once a month vs. Never | 1.25 (0.66 - 2.36) | 4.52 (2.07 - 9.89)*** | 2.61 (1.29 - 5.25)** | 1.62 (0.77 - 3.41) |
| At least few times a week vs. Never | 1.28 (0.69 - 2.40) | 4.35 (1.88 - 10.07)** | 2.41 (1.06 - 5.49)* | 2.03 (0.88 - 4.71) |
| **Needle sharing** | | | | |
| At least once a month vs. Never | 0.90 (0.46 - 1.76) | 4.24 (1.74 - 10.37)** | 2.50 (1.18 - 5.32)* | 3.21 (1.45 - 7.14)** |
| At least few times a week vs. Never | 1.18 (0.64 - 2.17) | 4.35 (1.80 - 10.54)** | 2.31 (1.06 - 5.00)* | 1.68 (0.75 - 3.76) |
| **Condom use** | | | | |
| At least once a month vs. Never | 0.88 (0.46 - 1.69) | 2.10 (0.97 - 4.57) | 1.96 (0.95 - 4.03) | 2.81 (1.28 - 6.17)* |
| At least few times a week vs. Never | 0.56 (0.30 - 1.04) | 2.25 (1.05 - 4.84)* | 1.93 (0.91 - 4.07) | 3.06 (1.35 - 6.95)** |

*P<0.05; **P<0.01; ***P<0.001; CI: confidence interval; OR: odds ratio; T1: baseline visits; T2: 6-month visit; T3: 12-month visit; T4: 18-month visit

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# Curriculum Vitae


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### EDUCATION

**JOHNS HOPKINS BLOOMBERG SCHOOL OF PUBLIC HEALTH** — Baltimore, MD

*Master of Science in Epidemiology, Concentration in Infectious Diseases* — Sep 2012 – May 2014

*Certificate in Health Management and Finance*

- Awarded the Anna Huffstutler Stiles Scholarship for graduate research in Epidemiology 2014
- Awarded the Miriam E. Brailey's Fund for graduate training in Epidemiology 2013
- Vice President for Quality of Life for Student Assembly
- Social Chair for Epidemiology Student Organization

**MOUNT HOLYOKE COLLEGE** — South Hadley, MA

*Bachelor of Arts in Biochemistry and Italian Language* — Sep 2003 – May 2007

- Honors: Cum Laude
- Mount Holyoke College full academic scholarship for all four years
- Awarded Howard Hughes Medical Institute (HHMI) Scholarship and CASCADE Mentoring Scholarship for research on "modes in which small molecules interact with DNA"
- Awarded Mary Vance Young Scholarship and Laurel Fellowship to study abroad in Florence, Italy
- Co-captain of tennis team, played varsity tennis for all four years

**RED CROSS NORDIC UNITED WORLD COLLEGE** — Flekke, Norway

*International Baccalaureate* — Sep 2001 – May 2003

- One of four students from Croatia awarded a scholarship to attend United World College

### EXPERIENCE

**JOHNS HOPKINS BLOOMBERG SCHOOL OF PUBLIC HELATH** — Baltimore, MD

*Intern – Maryland Department of Health and Mental Hygiene* — Oct 2013 – Present

- Developing Clinical Quality Management Plan for the Ryan White Part D Network
- Evaluating the effectiveness of the care delivery to women, infants, children and youth impacted by HIV / AIDS and developing recommendations for future use of Ryan White funding

*Teaching Assistant – Department of Epidemiology* — Sep 2013 – Present

- Developing course materials and course webpage as well as holding office hours for students

*Data Analyst – Department of Health, Behavior and Society* — Jun 2013 – Present

- Analyzing data of a randomized trial assessing the impact of peer-based, personal risk network-focused HIV prevention intervention on frequency of conversation about HIV prevention topics among injection drug users in Baltimore

*Research Assistant – Center for Public Health and Human Rights* — Feb 2013 – Present

- Conducting systematic literature reviews on global HIV prevalence in sex workers, as well as on behavioral and social determinants of the temporal trends in HIV epidemiology among men who have sex with men in Central Asia

**THE ROCKEFELLER UNIVERSITY** — New York City, NY

*Laboratory Manager – Laboratory of RNA Molecular Biology* — Feb 2011 – May 2012

- Managed the monthly operating budget
- Quality improvement of laboratory operations by developing a manual that addressed standard operating procedures and issues with maintenance of equipment, sample storage system, databases and inventories
- Trained new laboratory members among which were students and post-doctoral fellows as well as visiting scientists in techniques unique to the laboratory

**THE ROCKEFELLER UNIVERSITY** New York City, NY

*Research Assistant – Laboratory of RNA Molecular Biology* Jul 2007 – Jan 2011

- Conducted research that required high level of independence in designing experiments, troubleshooting and interpreting results; also presented research at laboratory meetings
- Worked in teams that involved lab members, as well as other scientists from Rockefeller University, neighboring institutions (such as Memorial Sloan-Kettering Hospital), and other states and countries
- Actively contributed to the development and maintenance of a database for over 3,000 samples
- With other post-doctoral fellows improved small RNA profiling protocol unique to the laboratory
- Advised numerous laboratories on collection and quality control of the samples and application of small RNA profiling

## PUBLICATIONS

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**PERSONAL**

- Born on November 20th, 1984 in Sibenik, Croatia
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- **Programs:** STATA 12, SAS 9.3, Microsoft Office, Adobe Photoshop, Adobe Illustrator
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- **Interests:** Tennis, Golf, Dancing, Languages