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Drug Users' Willingness to Encourage Social, Sexual, and Drug Network Members to Receive an HIV Vaccine: A Social Network Analysis

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Abstract

This study examined feasibility of peer-based promotion of HIV vaccination and dyadic correlates to vaccine encouragement in risk- and non-risk networks of drug users ($n = 433$) in the US. Data were collected on HIV vaccine attitudes, risk compensation intentions, likelihood of encouraging vaccination, and recent (past 6 months) risk (i.e. involving sex and/or injecting drugs) and non-risk (i.e. involving co-usage of noninjected drugs and/or social support) relationships. Willingness to encourage HIV vaccination was reported in 521 and 555 risk- and non-risk relationships, respectively. However, 37 % expressed hesitancy, typically due to fear of side effects or social concerns. Encouragement was often motivated by perceived HIV risk, though 9 % were motivated by risk compensation intentions. In non-risk partnerships, encouragement was associated with drug co-usage, and in risk relationships, with perceived vaccine acceptability and encouragement by the partner. Network-based HIV vaccine promotion may be a successful strategy, but risk compensation intentions should be explored.

Keywords

HIV vaccines; Psychosocial; Social networks; Injection drug use; Rural health

Introduction

A preventive HIV vaccine could make a substantial impact on the epidemic [1–3]. However, given that the first vaccines are likely to be only partially effective, successful dissemination among men who have sex with men, people who inject drugs (PWID), and high-risk heterosexual populations will be critical [1]. Unfortunately, research on potential strategies for achieving adequate coverage among high-risk populations is currently lacking.

A number of vaccine-related characteristics (e.g., efficacy, duration of protection, side effects, cost) and psychosocial factors (e.g., risk perception, perceived benefits of vaccination) may play a role in HIV vaccine acceptability [4]. Several studies have also highlighted the potential negative impact of social concerns, particularly those about stigmatization and negative peer reactions, on vaccine uptake [5–10]. Social concerns reported in previous studies include fear that others will perceive vaccination as a sign of promiscuity [9–11] and that family members [6, 7] and intimate partners [6, 7, 11, 12] will have a negative reaction. As a result, recent conceptual models of HIV vaccine uptake and clinical trial participation include social networks, norms, and peer influence among the key determinants [10, 13].

This evidence underscores the prominent role of social influence on HIV vaccine acceptability. Several studies have emphasized the importance of involving local individuals in HIV vaccine promotion [14–18], and some have specifically alluded to the importance of vaccine communication between intimate partners [7, 11]. Yet, despite these findings, few quantitative studies have explored social influences related to HIV vaccination [4]. Though some studies have examined individuals' willingness to discuss clinical trial participation [18–22], findings may not be generalizable the promotion of an approved HIV vaccine. Moreover, with rare exception [22], studies have not investigated with whom participants would discuss trial participation. These limitations present an important gap in understanding, as vaccine promotion may not be an all-or-none phenomenon, but one that individuals engage in selectively depending on personal characteristics, the attributes of the peer, and/or the nature of the relationship.

Understanding the characteristics of relationships in which HIV vaccine promotion is most likely to occur is important to determining not only the feasibility of a peer-based strategy, but also its ability to reach those most at risk. The purpose of this study was to investigate drug users' willingness to encourage their risk partners and other peers to receive an HIV vaccine and, through dyadic analysis, determine in which relationships vaccine encouragement was most likely to occur.

Methods

Sample

Data used were collected during the 24-month follow-up assessment of the Social Networks among Appalachian People (SNAP) study. SNAP is a longitudinal study to determine the prevalence of and risk factors for HIV, hepatitis C, and herpes-simplex 2 among illicit drug users in a rural community in Central Appalachia. The eligibility criteria included the following: (1) being 18 years of age or older, (2) a resident of an Appalachian county in Kentucky, and (3) using prescription opioids, heroin, crack/cocaine or methamphetamine to get high in the prior 30-day period. Participants (n = 503) were recruited using respondent driven sampling. Data were collected via interviewer-administered questionnaires at baseline and at 6-month intervals thereafter. HIV testing was performed at baseline and each follow-up using the OraQuick® ADVANCE™ Rapid HIV-1/2 Antibody Test (OraSure, Bethlehem, PA, USA). Additional details about the SNAP study are published elsewhere [23, 24].

From March 2012 to May 2013, participants (n = 435) completed their 24-month SNAP study interview. All participants tested HIV negative. After the interview, participants (n = 433) were invited to complete an interviewer-administered questionnaire on their attitudes toward HIV vaccination and willingness to encourage others to receive the vaccine. Two participants interviewed in jail were not invited due to time limits. All participants provided written informed consent and were compensated \$35 for participation. The University Institutional Review Board approved the protocol and a Certificate of Confidentiality was obtained.

Network Data Collection

The SNAP interview elicited network data (described in detail elsewhere [24]). Briefly, each participant, or 'ego', gave the first name and last initial of up to eight individuals from/with whom they had received social support, used drugs (excluding alcohol and marijuana), and engaged in sex during the past 6 months. For each network member, or 'alter', named, additional demographic information was gathered (e.g., gender and approximate age). To determine if an alter was a participant in the SNAP study, their name and demographic information was cross-referenced against that of participants enrolled in the study and through consultation with the community-based staff. These techniques are consistent with those used in other studies [25–27].

For the purposes of these analyses, a risk network and non-risk network were constructed. The risk network consisted of sexual relationships and/or relationships in which partners injected drugs together. The non-risk network consisted of all other relationships (i.e. social support and co-usage of non-injected drugs). Of note, both networks included all named alters (participants and non-participants). NetDraw (version 2) [28] was used for network visualization.

Demographic Similarity—Two dyadic measures of demographic similarity between the ego and each of his/her alter(s) were evaluated: gender (1 = same gender, 0 = different

gender) and absolute difference in age (years). Of note, the age difference was based on ego's report of alter(s)' ages, as the actual ages of alters not in the study were unknown. Other measures of demographic similarity could not be assessed, as egos were not asked about other demographic characteristics of alters.

Ego and Alter Characteristics—Alter characteristics, as reported by the respondent, were also analyzed; these included alter gender, age (years), and recent (past 6 month) injection drug use (IDU; binary). Respondent's gender, age, and recent IDU were also examined, as was their perceived benefit of HIV vaccination. The latter was assessed with the following item: "In your opinion, how much would an HIV vaccine benefit you?" [1 = not at all, 2 = a little, 3 = some, 4 = a lot]. Respondents were also asked about the HIV status of each alter; however, all alters were reported to be HIV negative with the exception of one social support alter. Therefore, alter HIV status was unable to be evaluated as a covariate in analysis.

Relationship Characteristics—Respondents were asked how long they had known each of their alters (months), how frequently they communicated (6-point Likert scale, with increasing values representing more frequent communication), geographic distance between their residences (9-point Likert scale with increasing values indicating farther distances), trust in each alter (10-point scale), whether or not the alter was a family member (binary), and whether or not the respondent received social support and financial support from each alter (both binary).

Risk Behavior—Seven dyadic measures of risk behavior were analyzed. Six were binary and represented whether or not the respondent had (1) used drugs with the alter, (2) injected drugs with the alter, (3) injected drugs and had sex with the alter, (4) given used injection equipment to alter, (5) received used injection equipment from the alter, and (6) discussed risk reduction (i.e. condom use and/or bleaching injection equipment). The seventh contained data representing a scale of the frequency of HIV risk behavior, in which the values of the ties represented the sum of three Likert scales on which participants rated the frequency of unprotected sex (4-point scale) and of needle and cooker sharing (5-point scales) with the alter. The summative scale was also disaggregated to allow for separate evaluations of the frequency of unprotected sex and equipment sharing.

Psychosocial Measures—Three psychosocial measures used were also analyzed. These items, asked only about risk network members, examined descriptive and injunctive norms, risk perception, and intent to engage in risk compensation. Descriptive norms are perceptions about others' behaviors, while injunctive norms relate to a person's beliefs about what others think he/she should do [29, 30]. Descriptive and injunctive norms were assessed on an alter-by-alter basis with the following questions repeated for each named alter: "How likely do you think [network member] would be to get an HIV vaccine?" and "If [network member] got an HIV vaccine, how likely would they be to encourage you to get it?" Responses were given on 4-point Likert scales ranging from 'very unlikely' to 'very likely'. Using the same Likert-scale response option, participants were also asked about dyad-specific risk perceptions: "How likely do you think it is that [network member] would ever

get infected with HIV?” and “How likely do you think it is that [network member] would ever infect you with HIV?”

Risk Compensation Intent—Respondents answered three items to assess intent to engage in sexual risk compensation: “If [you/alter/you and alter] got an HIV vaccine that was 90 % effective, would you use a condom with them... [‘Much less often’, ‘Less often’, ‘More often’, ‘Much more often’, ‘We wouldn’t change how often we used a condom’]”. Three injection-related items with the same response options were also given: “If [you/alter/you and alter] got an HIV vaccine that was 90 % effective, would you share injection equipment...”. These data were used to compute a binary variable in which 1 = intent to increase their risk behavior on any one of the six risk compensation items, and 0 = intent to decrease or maintain the same level of risk behavior if vaccinated.

Encouragement and Discouragement of HIV Vaccination—Participants were asked, “If an HIV vaccine that was 90 % effective was available, who would you encourage to get it?”, and “If an HIV vaccine that was 90 % effective was available, who would you discourage from getting it?” Each question was followed by three response options, “everyone”, “no one”, and “some select people”. Participants who selected “everyone” were assumed to be willing to encourage/discourage all of their network members, and those who responded “some select people” were given a checklist of their named network members to indicate which ones they would encourage/discourage. These data were used to compute the outcomes for dyadic analysis of the risk and non-risk network, representing whether a respondent would encourage (1) or not encourage (0) their alter to receive the vaccine. Participants could free-list other individuals whom they would encourage, but because relational characteristics were unknown, these data were not included in dyadic analyses. On a separate item in the questionnaire, respondents completed a checklist-style question (developed in consultation with study field staff) to clarify why they would/would not be hesitant to encourage others to receive the vaccine. Respondents were also given an open-ended response option.

Statistical Analyses

Dyadic analyses were conducted to determine the correlates to encouragement of HIV vaccination in both the risk and non-risk networks. Given potential autocorrelation among dyads involving the same ego (i.e. naming of multiple partners by the same participant), generalized linear mixed models with a random effect for ego were used. Models were estimated using the PROC GLIMMIX [31] procedure (SAS version 9.3) and empirical (sandwich) estimators. Vaccine encouragement was regressed on each of the demographic, psychosocial, and behavioral measures described above. Psychosocial and behavioral measures only applied to risk dyads and were not entered in the analysis of non-risk dyads. To adjust for inflated probability of Type 1 error due to multiple comparisons, the threshold for statistical significance was adjusted using the Šidák method (i.e., $1 - [1 - \alpha]^{1/n}$, where n represents the number of pairwise comparisons) [32]. Therefore, $p < 0.0017$ and $p < 0.0030$ indicated statistical significance for the risk and non-risk dyadic analyses, respectively. Covariates reaching $p < 0.05$ in bivariate analyses were entered into multivariate analyses to

examine their independent association with vaccine encouragement. Odds ratios (ORs), adjusted odds ratios (AORs), and 95 % confidence intervals (CIs) were reported.

Results

Table 1 displays participants' demographic and behavioral characteristics and the composition of their risk network. Briefly, the median age was 34 years (range 21–68), 45 % were female, and 94 % were White; the latter is reflective of the demographic profile of Central Appalachia [33]. The majority were not married (74 %). Most (76 %) reported a lifetime history of IDU and 34 % reported IDU in the past 6 months. In the past 6 months, approximately 24 % had multiple sex partners and 71 % had unprotected sex. Nearly all (95 %) reported nonmedical use of prescription drugs in the past 6 months and few reported use of cocaine (12 %), methamphetamine (8 %), heroin (5 %), or crack (3 %) (data not shown). Most participants ($n = 356$) reported at least one risk tie. The risk network contained 582 relationships; 78 % were sexual only, 12 % involved injecting together, and 10 % involved injection and sex. Of note, only two sexual relationships involved sex between two men. The non-risk network contained 850 relationships; 26 % involved drug co-usage and social support, 50 % involved social support only, and 24 % involved drug co-usage only.

Most participants ($n = 273$, 63.0 %) would encourage everyone to receive the vaccine and relatively few ($n = 30$, 6.9 %) would encourage no one to receive the vaccine. Almost one-third ($n = 129$, 29.8 %) reported that they would encourage HIV vaccination to only some select people. In the risk and non-risk networks, there were 521 and 555 relationships in which in which a person was willing to encourage vaccination, respectively. Overall, 92.8 % ($n = 402$) would encourage at least one person to receive the vaccine.

Only 13 (3.0 %) participants reported that they would discourage someone from getting the vaccine, including eight (1.8 %) who would discourage everyone and five (1.2 %) who would discourage only some select people. In total, participants would discourage vaccination among nine alters in the risk network and 21 in the non-risk network. However, in eight of the 30 relationships involving discouragement, the respondent also reported that they would encourage vaccination. These relationships were analyzed as ties involving encouragement.

Data on encouragement and discouragement of vaccination within the risk and non-risk networks are displayed in Figs. 1 and 2, respectively. As shown in Figs. 1 and 2, willingness to encourage HIV vaccination (indicated by green arrows) was common despite extensive heterogeneity in the types of relationships (indicated by line color). The figures also show that many of the most highly connected participants in the risk and non-risk networks were willing to promote the HIV vaccine to all of their network partners. Interestingly, although discouragement of vaccination (indicated by red arrows) in the risk network was uncommon, the location and directionality of discouragement in the network is notable. For example, the most central person in the largest component of the network (shown in the bottom right corner of Fig. 1) would be discouraged from getting the vaccine by one of their partners.

Factors Affecting Willingness to Encourage Vaccination

Table 2 describes reported factors that would affect respondents' decision to encourage others to get the vaccine. The most endorsed factor was perception that the other person was at risk for HIV (58 %), followed by the desire to prevent acquisition of HIV from the person (37 %). Of note, 7 % would encourage others so that they could reduce their condom use and 4 % so that they could share works more frequently. When asked if they would be hesitant about recommending the vaccine, 63 % reported they would not. Reasons given for hesitancy among the remaining 160 participants are listed in Table 2. The most common reason was fear of side effects (57 %), followed by feeling that it was "not their place to tell them what they should do about their health" (41 %) and fear of offending the person (34 %). Embarrassment and fear that the person would suspect the respondent of having HIV was reported by 19 and 17 %, respectively.

Correlates to HIV Vaccine Encouragement in the Risk Network

Among participants ($n = 356$) who named risk network partner(s), 67 % named only one, 19 % named two, 6 % named three, and the remaining 8 % named four to eight. Bivariate results are described in Table 3. Perceptions that an alter would be likely to accept the vaccine (descriptive norms; OR 3.45, 95 % CI 2.48–4.81, $p < 0.001$) and to encourage the respondent to do so (injunctive norms; OR 2.94, 95 % CI 2.09–4.12, $p < 0.001$) were positively associated with likelihood of encouraging an alter to receive an HIV vaccine. Respondents' rating of the personal benefit of HIV vaccination was positively associated with likelihood of encouraging vaccination (OR 1.96, 95 % CI 1.43–2.69, $p < 0.001$). Of note, there was perfect correspondence between risk compensation intent and vaccine encouragement; every relationship involving intended risk compensation also involved vaccine encouragement. In multivariate analyses, only injunctive (AOR 1.85, 95 % CI 1.22–2.82, $p = 0.004$) and descriptive norms (AOR 2.60, 95 % CI 1.54–4.38, $p < 0.001$) remained significantly associated with encouragement.

Correlates to HIV Vaccine Encouragement in the Non-Risk Network

Among participants ($n = 361$) who named non-risk network partner(s), 34 % named only one, 29 % named two, 17 % named three, 13 % named four, and the remaining 8 % named five to eight. In non-risk relationships, respondents were less likely to encourage alters from whom they received financial support (OR 0.55, 95 % CI 0.39–0.79, $p = 0.001$) and more likely to encourage those with whom they reported using drugs (OR 1.96, 95 % CI 1.30–2.97, $p = 0.001$). Respondents who perceived greater personal benefits of HIV vaccination were more likely to encourage alters' vaccination (OR 2.52, 95 % CI 1.86–3.41, $p < 0.001$). In multivariate analyses, drug co-usage remained significantly associated with encouragement (AOR 1.61, 95 % CI 1.02–2.56, $p = 0.043$), as did perceived benefits of vaccination (AOR 2.40, 95 % CI 1.76–3.27, $p < 0.001$).

Discussion

In this sample of HIV-negative drug users, the majority (63 %) was willing to encourage all of their risk and non-risk alters to receive a preventive HIV vaccine. However, 30 % reported they would be selective in whom they would encourage and 37 % reported that they

would be hesitant. The latter was most commonly attributed to fear of side effects, but embarrassment and fear of offending or provoking suspicion among those encouraged were concerns reported by a sizeable minority. Given the persistence of stigma in areas most heavily impacted by the HIV epidemic [34], these psychosocial influences will be important to address via social marketing and community mobilization prior to and during vaccine dissemination.

Despite potential barriers to HIV vaccine encouragement among peers, the overwhelming majority reported that they would encourage at least one person to receive the vaccine and only 3 % reported that they would discourage vaccination. Previous studies have demonstrated the ability of a few index individuals to encourage trial participation among a vast number of peers [18, 22], but the present study is the first to use a social network approach to examine intended peer-promotion of an approved HIV vaccine. In the current study, 433 participants reported willingness to encourage vaccination in 1,076 relationships. The number who would receive a recommendation to be vaccinated could not be determined due to an inability to determine overlap among alters not participating in the study. However, findings clearly indicate that a peer-based approach to HIV vaccine promotion could be feasible in this population. Further, given that the most commonly endorsed reasons for encouraging vaccination were partner(s)' HIV susceptibility and/or HIV risk posed by partner(s), these data provide formative evidence that peer-promotion could be effective in reaching those most at risk.

Dyadic analyses of the risk network revealed that, controlling for other factors, risk perception was not significantly associated with encouragement. Instead, the strongest correlates to encouragement were those related to social norms; participants were more likely to encourage risk network members who they believed would accept the HIV vaccine and who would reciprocate the encouragement. The finding on the impact of perceived reciprocity of encouragement is complex. First, while the data may suggest that participants are more likely to encourage those whom they believe will return the encouragement, the desired temporality in this communication is unknown. For example, individuals may avoid initiating encouragement and only encourage those from whom they have already received encouragement (i.e. due to the issues of stigma and mistrust described above). In this case, the tendency toward hesitance may slow peer-driven promotion of the vaccine. Nevertheless, the findings reiterate the critical role that social concerns will play in facilitating or inhibiting the diffusion of positive vaccine messages through the social networks of those most at risk.

Although the associations did not reach statistical significance after adjustment for multiple comparisons, the gender differences revealed in the dyadic analysis of the risk network are notable and warrant mention. The analyses indicated that men were somewhat less likely to encourage HIV vaccination to their risk partners, but more likely to receive encouragement to get vaccinated. The finding may suggest that women could play a particularly important role in promoting the vaccine within their risk networks and that peer-based promotion may be an especially effective way of reaching men with positive vaccine messages. In previous research among high-risk adults recruited in Los Angeles, men reported that their HIV vaccination decision would be more influenced by their peers [7]. In light of previous

research, the finding that women are less likely to receive encouragement is also notable, as many women report fear of their partner's reaction as an influential factor in their HIV vaccine acceptability [11]. Thus, additional analyses are needed to determine men's receptivity to peer-promotion, and further research is needed to explore potential barriers to and consequences of women's promotion of the vaccine.

Another important finding from the present study is the relationship between vaccine encouragement and risk compensation intent. In every relationship in which the respondent intended to increase risk behavior if they or their partner received an HIV vaccine, the respondent also reported intent to encourage vaccination. In fact, 9 % of participants cited a desire to decrease condom use and/or increase equipment sharing as a motivation to encourage HIV vaccination among partners. If individuals intend to encourage vaccination among those most at risk for HIV and to risk compensate with those they encourage, this dynamic could present a negative unintended consequence of peer-promotion of a partially effective HIV vaccine. Supplementary analyses revealed that risk compensation intent was predominantly related to reduced condom use and that those intending to risk compensate did not require that they and their partner both be vaccinated. Of note, this study queried participants about their attitudes on and willingness to encourage a 90 % effective vaccine; some previous research indicates that a vaccine of lower efficacy (actual or perceived) may prompt less risk compensation [35–38]. The degree of risk compensation necessary for offsetting the positive effect of a partial, highly efficacious vaccine is likely great [3, 39, 40], particularly when vaccine coverage is high [1, 41]. Thus, although the prospect of developing a vaccine with full efficacy currently appears bleak, continued effort in vaccine development is certainly warranted. The impact of a partially efficacious vaccine will depend on achieving adequate coverage, which in turn relies on the development of innovative strategies for reaching those most at risk. This study indicates that a network-based mechanism may be an effective approach, but the data clearly highlight a need for future research on peer-promotion of HIV vaccination to include a measure of risk compensation intent, and for simulation studies examining the impact of promotion strategies to consider potential for risk compensation.

Interpretation of the findings from this study should be done in consideration of its limitations. At this stage of vaccine development, research is limited to examining individuals' intentions to perform behaviors related to HIV vaccination, but as some have noted [42], the correspondence between intentions and behavior may be limited in some cases. Similarly, the efficacy of future HIV vaccines is currently unknown; the present study focuses on behaviors and attitudes in the context of a 90 % effective vaccine and additional research is needed to explore these findings' generalizability to vaccines of lower efficacy. Ideally, questions could be repeated across a range of efficacy-levels, but this approach was time-prohibitive in the current study given the inclusion of an extensive network inventory. In the current study, a 90 % efficacy level was chosen for three reasons, (1) it presented a near 'best case scenario' for evaluation of acceptability and encouragement, (2) it was expected to precipitate a conservative, or near 'worst case scenario', estimate of risk compensation, and (3) it allowed for the examination of the underlying psychosocial constructs that affect attitudes toward the vaccine while controlling, in a sense, for the impact of efficacy. The study was among the first to use a sociometric network approach;

however, the study was limited in its ability to determine overlap between some network ties due to the naming of alters who were non-participants. Also, self-reported behavioral data may be subject to social desirability and/or recall bias. Finally, although participants in this study exhibit high levels of HIV risk behavior [24, 43, 44], all were HIV-negative (and aware of their serostatus), and they lived in a community that currently has a low HIV prevalence. In fact, since 1982, there have been only 59 HIV diagnoses in the eight-county area development district surrounding the study site (based on residence at time of diagnosis) [45]. The generalizability of this study's findings to populations of higher prevalence and among individuals who are not aware of their serostatus is unknown. Nevertheless, it is important to explore issues surrounding HIV vaccine acceptability and promotion in high-risk, low-prevalence populations that remain under-studied and in which a truly pre-emptive approach to HIV prevention is possible.

Conclusions

The present study is the first social network study to focus on drug users' willingness to encourage HIV vaccination among their risk and non-risk peers. While the findings should be generalized with caution, the study demonstrates the potential of a peer-based strategy to HIV vaccine promotion among people using drugs and underscores the need for additional behavioral research. Future simulation studies are also needed to examine the efficiency of a peer-based approach compared to and/or in conjunction with other marketing strategies. This study raises important topical and methodological areas for further research. Consistent with previous studies [19, 22], the data demonstrate that future research should include measures of respondents' selectivity in communicating about HIV vaccination, specifically assessing to whom they would promote vaccination and/or trial participation. This study also highlights the need to explore risk compensation intentions among those willing to promote the vaccine. Most importantly, additional studies are needed to explore strategies for promotion of HIV vaccination among PWID. When an HIV vaccine is made available, expediency in roll-out will be important, as delays in dissemination could "result in millions of new infections that might otherwise have been averted" [4], p. 1755).

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Fig. 1.
Encouragement and discouragement of HIV vaccination in a risk network^a of people who use drugs. ^aRisk relationships include those in which partners engage in sex and/or injection drug use

Fig. 2.

Encouragement and discouragement of HIV vaccination in a non-risk^a network of people who use drugs. ^aNon-risk relationships include those in which the alter provides social support and/or the partners use drugs together (not including injection drug use)

Table 1

Individual- and network-level characteristics of the sample (n = 433)

Characteristic	N (%)
Individual-level	
Demographic	
Male	239 (55.2)
Age—median (IQR)	34 (29–41)
White	407 (94.0)
High school graduate	251 (58.0)
Married	111 (25.6)
Unemployed	169 (39.0)
Income in past 30 days ^a —median (IQR)	\$698 (200–1,100)
Uninsured	285 (65.8)
Injection drug use	
Lifetime history of injection drug use	331 (76.4)
Injection drug use in past 6 months	146 (33.7)
Injected with unclean needle in past 6 months	33 (7.6)
Gave/loaned/sold unclean needle in past 6 months	16 (3.7)
Shared injection equipment in past 6 months	55 (12.7)
Sexual behavior (past 6 months)	
Number of sex partners	
Zero	76 (17.6)
One partner	254 (58.7)
Two partners	56 (12.9)
Three or more partners	47 (10.9)
Unprotected sex with at least one partner	308 (71.1)
Unprotected sex with PWID	85 (19.6)
Network-level	
Risk network	
Number of relationships involving sex and IDU ^b	60
Number of relationships involving sex only	451
Number of relationships involving IDU ^b only	71
Non-risk network	
Number of relationships involving drug co-usage ^c and social support	219
Number of relationships involving social support only	429
Number of relationships involving drug co-usage ^c only	202

IQR interquartile range; PWID person who injects drugs; IDU injection drug use

^aIncludes income from employment, unemployment compensation, welfare, pension/social security, child support, friends/family, and illegal activities

^b Reported engaging in injection drug use together

^c Reported using non-injected drugs together

Table 2

Factors affecting respondents' decisions to recommend the HIV vaccine to others (n = 433)

Factors	N (%)
Reasons for encouraging HIV vaccination (n = 432)	
Belief that the person was at risk for HIV	249 (57.5)
Desire to protect oneself from acquiring HIV from the person	158 (36.5)
"In case [the person] started having unprotected sex or sharing works with other people" ^a	64 (14.8)
Desire to use condoms less frequently	32 (7.4)
Desire to share works more frequently	19 (4.4)
None of the above	169 (39.0)
Other ^b	4 (0.9)
Reasons for hesitancy in encouraging HIV vaccination (n = 160)	
Fear that the person would have side effects	91 (56.9)
"Not my place to tell them what they should do about their health"	65 (40.6)
Fear of offending the person	55 (34.4)
Belief that it would not make a difference in the person's decision	43 (26.9)
Embarrassed to discuss HIV vaccination with them	30 (18.8)
Fear that the person would suspect me of having HIV	27 (16.9)
None of the above	8 (5.0)
Other ^c	2 (1.3)

^aThe question wording does not specify if this reasoning was based on motive to protect the person, oneself, or the new partner(s) from HIV acquisition

^bOthers include: "I would just want everyone to be protected", "I wouldn't hesitate to tell anyone", "I'd recommend it to anyone to protect them and their family.", "It's not 100 % and there is going to be a risk"

^cOthers include: "I don't believe in vaccinations", "I wouldn't want to encourage anyone one way or the other"

Table 3

Dyadic correlates to encouragement of HIV vaccination (n = 432)

	Risk network (582 dyads)		Non-risk network (851 dyads)	
	OR (95 % CI)	p-value	OR (95 % CI)	p-value
Demographic similarities				
Same gender ^a	1.27 (0.50–3.20)	0.620	1.06 (0.80–1.40)	0.695
Age difference ^{a,b} (years)	1.00 (0.96–1.04)	0.938	0.99 (0.98–1.01)	0.263
Relationship characteristics				
Duration (months) ^a	1.00 (1.00–1.01)	0.119	1.00 (1.00–1.00)	0.055
Frequency of contact ^a	5.37 (0.93–1.50)	0.172	0.91 (0.73–1.12)	0.354
Distance ^c	1.00 (0.98–1.02)	0.623	1.01 (0.99–1.04)	0.349
Kinship	0.84 (0.42–1.69)	0.620	0.72 (0.54–0.97)	0.032
Trust ^a	1.07 (0.98–1.16)	0.154	0.98 (0.92–1.04)	0.502
Social support	1.22 (0.70–2.12)	0.491	0.68 (0.44–1.05)	0.085
Receives financial support	1.35 (0.76–2.42)	0.306	0.55 (0.39–0.79)	0.001*
Psychosocial				
Descriptive norms ^d	3.45 (2.48–4.81)	<0.001*	–	–
Injunctive norms ^d	2.94 (2.09–4.12)	<0.001*	–	–
Partner's risk for HIV ^d	1.46 (0.96–2.24)	0.078	–	–
HIV risk posed by partner ^d	1.72 (0.99–3.00)	0.054	–	–
Risk compensation intent	– ^e	– ^e	–	–
Behavior				
Use drugs together	1.88 (0.99–3.56)	0.053	1.96 (1.30–2.97)	0.001*
Inject drugs together	2.56 (0.91–7.25)	0.076	–	–
Distributive needle sharing	1.45 (0.36–5.79)	0.600	–	–
Receptive needle sharing	2.63 (0.89–7.82)	0.082	–	–
Inject together and sex	1.61 (0.56–4.60)	0.376	–	–
Frequency of risk behavior	0.97 (0.85–1.09)	0.566	–	–
Frequency of unprotected sex	0.82 (0.63–1.05)	0.120	–	–
Frequency of equipment sharing	1.15 (0.91–1.46)	0.257	–	–
Risk reduction communication	1.79 (0.65–4.91)	0.258	–	–
Ego's characteristics				
Male	0.44 (0.21–0.89)	0.023	1.26 (0.68–2.35)	0.464
Age	0.99 (0.95–1.03)	0.555	0.98 (0.94–1.01)	0.223
Recent injection drug use	1.25 (0.62–2.53)	0.532	2.68 (1.34–5.34)	0.005
Perceived benefit of vaccine	1.96 (1.43–2.69)	<0.001*	2.52 (1.86–3.41)	<0.001*
Alter's characteristics				
Male	2.48 (1.34–4.58)	0.004	1.22 (0.91–1.64)	0.185
Age ^{a,b}	1.00 (0.97–1.04)	0.838	0.99 (0.98–1.00)	0.183

	Risk network (582 dyads)		Non-risk network (851 dyads)	
	OR (95 % CI)	p-value	OR (95 % CI)	p-value
Recent injection drug use	1.92 (0.93–3.97)	0.080	1.88 (1.20–2.95)	0.006

One person had missing data on the outcome measure

* Statistical significance based on p-values adjusted for multiple comparisons using the Šidák method ($p < 0.0017$ and $p < 0.0030$ for risk and non-risk analyses, respectively)

OR unadjusted odds ratio, CI confidence interval

^a In the non-risk network, 850 relationships were analyzed due to one missing value

^b In the risk network, 580 relationships were analyzed, as the ages for two alters were missing

^c In the risk and non-risk networks, 581 and 848 ties were analyzed due to missing values

^d In the risk network, 581 relationships were analyzed due to one missing value

^e There was perfect concordance between risk compensation intent and vaccine encouragement; every relationship involving intended risk compensation (30 dyads) also involved encouragement of vaccine uptake. However, the GLIMMIX model would not converge