THE RELEVANCE OF DRUG INJECTORS' SOCIAL AND RISK NETWORKS FOR UNDERSTANDING AND PREVENTING HIV INFECTION

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Abstract—Focusing on the social environment as well as the individual should both enhance our understanding of HIV transmission and assist in the development of more effective prevention programs. Networks are an important aspect of drug injectors' social environment. We distinguish between (1) risk networks (the people among whom HIV risk behaviors occur) as vectors of disease transmission, and (2) social networks (the people among whom there are social interactions with a mutual orientation to one another) as generators and disseminators of social influence. These concepts are applied to analyses of data from interviews with drug injectors in two studies. In the first study drug injectors' risk networks converge with their social networks: 70% inject or share syringes with a spouse or sex partner, a running partner, or with friends or others whom they know. Qualitative data from interviews with injectors in the second study also show that the social relationships between drug injectors and members of their risk network are often based on long-standing and multiplex relationships, such as those based on kinship, friendship, marital and sexual ties, and economic activity. In the first study the vast majority of injectors, over 90%, have social ties with non-injectors. Injectors with more frequent social contacts with non-injectors engage in lower levels of injecting risk behavior. Risk settings may function as risk networks: injectors in this study who inject at shooting galleries are more likely than those who do not to rent used syringes, borrow used syringes and inject with strangers. Since the adoption of a network approach is relatively new, a number of issues require further attention. These include: how to utilize social networks among drug injectors to reduce risk through peer pressure; how to promote risk reduction by encouraging ties between injectors and non-injectors; and how to integrate biographical and historical change into understanding network processes. Appropriate methodologies to study drug injectors' networks should be developed, including techniques to reach hidden populations, computer software for managing and analyzing network data bases, and statistical methods for drawing inferences from data gathered through dependent sampling designs.

Key words—HIV, AIDS, drug injectors, risk networks, social networks, networks, injecting drug users, IDUs

INTRODUCTION

Most analyses of how the human immunodeficiency virus (HIV) is transmitted from one person to another, or of how its spread can be prevented, have viewed this process mainly as a function of individual risk behaviors. While continued reduction or elimination of HIV risk behaviors by individuals is a major goal of prevention, it is by no means the whole story. When the focus is limited to the individual, risk reduction tends to be seen as an effect of individual change only. The assumption is that reductions in risk behavior can be achieved by changing the knowledge, attitudes and beliefs of those who are likely to become infected with HIV or of those who, already infected, may pass the virus on to others. Individually-focused projects often also distribute risk reduction materials and instructions on their use. The expectation is that persons who realize they are susceptible will reduce their high-risk behavior after they are educated about AIDS in culturally appropriate ways—at least if they are provided with the means to reduce their risk of becoming infected with HIV.

While evaluations of individually-focused interventions among both in-treatment and out-of-treatment drug injectors report reductions in drug risk behavior [1-10], such interventions have been less successful in changing sexual risk behavior [6, 8, 11, 12]. In addition, whether long-term change and the maintenance of risk reduction can be achieved through an individual approach has not yet been adequately demonstrated.

One possible explanation for the limited success of HIV risk reduction models which focus mainly on the individual is that the assumption that the primary agent and target of change is the individual is too restrictive. This assumption fails to adequately take into account the social environment—both the
micro-level environment of dyads and social networks and also the macro-level environment of historically-formed social institutions and structures [13]. These social environments may influence and constrain the extent to which individuals engage in risk reduction. The social environment can also affect viral transmission directly. Thus focusing on the social environment may elucidate HIV spread and prevention. assist in developing new types of interventions, and at the same time provide for a fruitful synthesis with more individually oriented analyses and interventions.

Studies of condom use indicate the importance of social pressure and support deriving from networks. For example, in an analysis of deliberate sexual risk reduction among street-recruited injecting drug users (IDUs), Abdul-Quader et al. [14] found that significant predictors included knowing someone with AIDS, ARC or HIV, having a friend or acquaintance who has engaged in sexual risk reduction, and having someone to talk to about problems and pressures during the last year. Similarly, Magura et al. [15], in a sample of 211 IDUs enrolled in a methadone maintenance program in New York City, found that greater partner receptivity was independently associated with condom use. In a longitudinal study by Catania et al. [16] of 600 gay men who were followed-up between 1984 and 1987, higher levels of social support were associated with increased condom use. Friedman et al. [17] and Jose et al. [18] reported on an HIV risk reduction intervention among drug injectors, the Community AIDS Prevention Outreach Demonstration (CAPD) intervention (described in more detail below), which targeted an entire neighborhood in New York City. In this intervention an effort was made to mobilize peer pressure among drug injector networks through group meetings, one-on-one counseling and the distribution of condoms and other risk reduction materials. Condom use increased among IDUs in the neighborhood and 51% of subjects who attended a group meeting always used condoms at follow-up compared to 25% of those who never attended ($P < 0.001$).

Our understanding of the pattern by which HIV spreads among drug injectors may also be enhanced by studying their networks [19–23]. Several studies (for example Allen et al. [24], and Des Jarlais and Friedman [25]) report that HIV seroprevalence among non-white drug injectors in the U.S. is higher than among whites, while other studies indicate that race remains a significant predictor even with behavioral controls (D'Aquila et al. [26], Friedman et al. [27], and Lewis and Watters [28]). One explanation for this pattern is that the relative isolation from each other of networks of drug injectors from different race/ethnic groups inhibits the spread of HIV among them. Differences in network processes might also have an impact. Thus, Wallace [29, 30] suggests that urban dislocation might have led to turnover in network membership and may have increased the rapidity with which HIV spread within the group.

Similarly, network factors may help explain the higher seroconversion rates among female drug injectors who have sex with women compared with other female IDUs (Friedman et al. [31]). The authors suggest that the drug injection networks of lesbian/bisexual women may include more gay/bisexual male IDUs. Thus female drug injectors who have sex with women may be more likely to inject unsafely with, or have unsafe sex with, HIV-infected gay/bisexual men.

Network approaches for understanding HIV among drug injectors draw on two functions of networks: their function as vectors of disease transmission, or risk networks, and their function as generators and disseminators of social influence, or social networks. We propose that a conceptual distinction between these functions will help to elaborate a network approach. Data are then presented which examine the extent to which drug injectors' risk networks converge with their social networks, and the influence which social ties may have on risk behavior. Finally, we extend the conception of a risk network by considering the role of anonymous risk networks and risk settings in spreading HIV.

**Risk networks**

Risk networks comprise those people with whom HIV risk behaviors occur. These networks may involve direct relationships, in which there is personal contact between people; or mediated relationships, in which the virus is transmitted through a host medium such as an infected syringe, without there being direct interaction among its users.

Direct relationships may occur between people who know one another or who are anonymous. An example of the first is when friends share syringes during the same injection event. An example of the second is when strangers share drugs from a common cooker (a container for heating and preparing the drug solution), as might occur in a shooting gallery (a public drug use setting where many injectors rent injecting equipment).

Mediated relationships may also occur between people who know one another or who are anonymous. For example, an injector might use a syringe (which has been 'stashed' (hidden or stored in a special place for later use) by a friend, or, in the case of an anonymous relationship, may use a discarded syringe which is infected with HIV [32, 33]. An important example of an anonymous mediated relationship is the use of rented syringes in shooting galleries. In the latter example, the shooting gallery is an institutional form of a risk network (a similar role in spreading HIV among gays was played by the bathhouse, where anonymous sex among many partners was a common activity in this setting).
Social networks

Social networks comprise those people with whom there are social interactions in which members are, at least potentially, mutually oriented to one another and may influence each other's behavior. These social interactions may stem from a variety of social relationships, such as those involving kinship, friendship, love, work, and economic exchange. They may also stem from a drug using relationship and include HIV risk behaviors (particularly in direct risk relationships between people who know one another). Thus social networks are analogous to what Milardo [34] has termed 'significant other' networks (comprising those who are considered 'close' or important') and 'exchange' networks (comprising those who provide or who are thought to provide material or symbolic support). Risk networks, on the other hand, are a limited form of Milardo's 'interactive networks' (those with whom interactions typically occur), in that they are restricted to interactions that involve the transmission of HIV via physical media, such as injection equipment, semen and blood. Since risk networks involve physical media, they can extend beyond direct interactive networks by including mediated interactions in which the medium (for example, the syringe, the cooker, stored blood or stored semen) acts as a host environment through which HIV can be transmitted.

Drug injectors' risk networks may converge with their social networks. Also, drug injectors may have additional social relationships with risk network members, such as sports or economic relationships, in which case they have multiplex social relationships with their risk network members. At the same time drug injectors may have social network members who are not members of their risk networks. The extent to which drug injectors are subject to the influence of members of their social network may be an important determinant of their HIV risk behaviors.

The influence of drug injectors' social networks on HIV risk behavior

Drug injectors' social networks may discourage or encourage HIV risk reduction. For example, drug injectors who have a valued social relationship with members of their risk networks may be more likely to share injection equipment with them if refusal might be interpreted as implying that they are infected with HIV—which could result in the break-up of the social relationship. However, social ties also have the potential to promote risk reduction. Social ties thus provide a mechanism for social influence and peer pressure to shape the values, beliefs and norms governing risk behavior.

We examine three issues related to whether or not drug-injector social networks can be a mechanism for reducing risk: (1) To what extent are drug injectors' risk networks also social networks? (2) What kinds of social ties link drug injectors to members of their risk networks? and (3) Do drug injectors' ties with non-injecting social network members influence their risk behavior?

METHODS

These three issues are examined using data from two recent studies of drug injectors in New York City—the Community AIDS Prevention Outreach Demonstration (CAPOD) project and the Social Factors and HIV Risk (SFHR) project.

The CAPOD project was an AIDS outreach and prevention intervention which was part of the National AIDS Demonstration Research (NADR) projects. It was conducted in the boroughs of Brooklyn, the Bronx and Queens in New York City, from January 1988 until August 1990. The project involved community organizing in one part of Brooklyn to encourage peer pressure in order to change the risk culture of injectors. The intervention in all boroughs included education about AIDS, AIDS counseling and HIV antibody testing. Subjects were street-recruited and interviewed by trained interviewers at intake and 6 months later. The interviews asked subjects about their HIV risk behaviors and about their social contacts. Subjects were eligible for the study if they were 18 years of age or older, not in treatment in the 30 days prior to the interview, and had injected during the previous 6 months.

The CAPOD data analyzed in this paper are from the intake interviews (the AIDS Initial Assessment) with 1124 street-recruited drug injectors. Latinos (mainly Puerto Rican) comprised 48% of the sample, blacks 39%, and whites 13%. The sample was 74% male and the mean age was 34. Twenty percent of the sample injected 5 years or less. Heroin was injected by over 90% and cocaine and speedball (a mixture of cocaine and heroin) by over 80%.

The analysis of quantitative data from the CAPOD project uses tests of statistical significance. However, drug injectors are to a large extent a hidden population for whom a sampling frame is not available. Thus, as with most studies of drug injectors, significance tests are indicative rather than exact.

The SFHR project, which began in 1990, was conducted in Brooklyn. It aimed, in part, to determine what factors are associated with a lower risk of HIV infection among particular groups of injectors, especially new and white injectors. In the first phase of the study ethnographic interviews were conducted over several days with individual injectors and ethnographic observations were undertaken in the study area. These methods were used to understand the varieties of drug-injector networks and social patterns in the study area and to develop a structured survey instrument and sampling plan for a survey of drug injectors' risk networks in the second phase.

The SFHR data described in this paper are from the first phase of the study. The subjects were recruited by street outreach as a convenience sample.
Table 1. The relationship of subjects to other injectors with whom they injected or shared syringes in the previous 6 months

<table>
<thead>
<tr>
<th>Category</th>
<th>%</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Injected alone all the time</td>
<td>29</td>
<td>319</td>
</tr>
<tr>
<td>2. Any injection with others:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(spouse or sex partner, running partner, friends or others subject knows, strangers)</td>
<td>71</td>
<td>770</td>
</tr>
<tr>
<td>Other injector categories*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Injected any time with others subject knows:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(spouse or sex partner, running partner, friends or others subject knows)</td>
<td>100</td>
<td>767</td>
</tr>
<tr>
<td>b. Any time with strangers</td>
<td>22</td>
<td>168</td>
</tr>
<tr>
<td>c. Any time with dyads:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>only spouse or sex partner</td>
<td>18</td>
<td>140</td>
</tr>
<tr>
<td>only running partner</td>
<td>42</td>
<td>320</td>
</tr>
<tr>
<td>both spouse or sex partner and running partner</td>
<td>20</td>
<td>151</td>
</tr>
<tr>
<td>d. Only with single dyads:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>spouse or sex partner with running partner</td>
<td>13</td>
<td>103</td>
</tr>
<tr>
<td>e. Multiple partners:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(friends or others subject knows, strangers, both spouse/sex partner and running partner)</td>
<td>16</td>
<td>126</td>
</tr>
</tbody>
</table>

*The percentages of other injector categories do not sum to 100 since these categories are not mutually exclusive.

from the local neighborhood (in Williamsburg, Brooklyn). Each subject was asked on successive days to give a detailed account of his or her daily activities (both risk behaviors and other activities), and to identify others with whom he or she had engaged in these activities. Thus, the descriptions, below, of the risk and social networks of index subjects rely on the information index subjects gave about their networks. Although the ethnographic data are based on the reports of index subjects who functioned as 'participant observers' on a '24/7' schedule (they 'hung out' round-the-clock, 7 days a week), the data are subject to certain limitations. Index subjects may not have accurate information about their network members; index subjects may have misconceptions about ties between members of their network; and since networks vary over time, interviews at different times may generate differing reports on the social ties among particular injectors.

RESULTS

The extent to which drug injectors’ risk networks are also social networks

Table 1* presents data about whom the subjects in the CAPOD project injected with or shared needles with during the 6 months prior to the interview. Of 1089 injectors for whom all data on drug-injecting partners were available, 29% always injected alone or never shared needles, while 71% (770) injected or shared syringes with others, i.e. in direct risk networks.

Of the 770 injectors who injected in direct risk networks, almost all (767 subjects) had injected or shared syringes with other injectors they knew (a spouse or sex partner, running partner, friends or others whom subjects knew). Only 22% of those who injected in direct risk networks reported injecting or sharing syringes with strangers. Moreover, 79% (611/770) of those injecting in direct risk networks did so with others with whom they were likely to have strong social ties. Thus 18% injected with a spouse or sex partner, 42% with a running partner, and 20% both with a running partner and with a spouse or sex partner.

Most of those in direct risk networks, however, did not restrict themselves exclusively to dyadic risk networks. While 30% (229) of the 770 injectors injecting in direct risk networks did so exclusively within single dyads (i.e. only with a spouse or sex partner, or only with a running partner), 70% of those injecting in direct risk networks did so with multiple injectors.

The above data indicate that risk networks often include persons who are also members of drug injectors’ social networks. Individual risk behavior is thus commonly embedded in social ties, whereby individual injectors engage in risk behaviors in the company of injectors with whom they have ongoing social relationships. However, the social ties which link drug injectors may vary in many ways, such as by their duration and in the type of social relationship upon which they are based. This variability in social ties among drug injectors is considered next.

The kinds of social ties linking drug injectors with members of their risk and social networks

To further illustrate how social ties link together members of drug injectors’ risk networks, we present

* Rounding has caused minor differences in some of the percentages between the text and Table 1.
Drug injectors' social and risk networks

Network member characteristics are described using positional parameters, which are located within the symbols indicating "risk network" and "social network only" members.

- = Risk Network Member

SG = Risk Network Member Who Attends Shooting Galleries

= Social Network Only Member

**Positional Parameter Codes and Values:**

1. **Member Identification** = Alphabetic letter(s), e.g. A, ZZ.
2. **Relationship to Index Subject** = e.g. Friend.
3. **Member's Gender** = Male, Female.
4. **Member's Ethnicity** = D (Dominican), PR (Puerto Rican), Latino
5. **Member's Age** = Age in years, e.g. 35 years old.
6. **Injector Status and Duration** = Inj. (injector), Ex-Inj. (ex-injector), Non-Inj. (non-injector), e.g. "Inj. 5" means Injector for 5 years.
7. **How Long Known and Duration** = Kn., e.g. "Kn. 4 yrs" means Known for 4 years.

* Other Codes:
  * "dck" = don't know.
  * Brief descriptions = as stated.

- = Link

**Injection Setting**

Southside Park, in Williamsburg (most drug network activity)

= Injection Setting

As described.

Scheme 1. Symbols and values for Figs 1 and 2.

Ethnographic data from the SFHR project (described above). These data are based on index subjects' reports about their risk and social networks.

In Fig. 1, John (J), the index subject, is a recently paroled 31-year-old injector of Puerto Rican origin who had been injecting (mainly heroin) for 10 years. He reported that there were 11 other injectors in his drug risk network, 9 of whom were friends and 2 acquaintances. John also named 4 other people. These included his ex-wife (W)—with whom he was continuing a sexual relationship—and 3 others, with whom he had only a social connection. They included his ex-mother-in-law (V), with whom he frequently stayed, and 2 non-injecting friends (Y and Z). He had known all 3 for 20 or more years. Eight members of his drug risk network were male and 3 were female. He had known 4 members of his drug risk network for 20 years or more, having grown up with them in the same neighborhood where he now lived. All the members of his drug risk network were Puerto Rican and were between 24 and 31 years of age. Several members had been injecting for a shorter period of time than he. John did not know how long many of the others had been injecting, particularly those he had known for less than 5 years.

*The names of subjects have been changed to alphabetic letters to preserve confidentiality.
John worked on odd jobs with 2 members of his risk network (R and U), repairing automobiles and working on building renovations. He had known each of these 2 men for more than 25 years. John pooled his resources with them to obtain drugs and other necessities. Several members of his risk network injected with one another. Four of these risk network members (R, S, T and U), along with John, formed a fully connected clique* in which the members injected with each other. In fact, members R, S, T and U were all related to one another (R, S and U were brothers and T was their cousin). However, this clique was not necessarily isolated from other risk networks. For example, John reported that T injected at shooting galleries (as did members G, H and AA). Thus T may have been a bridge to members of a larger risk network who also attended the shooting galleries which he attended. If T injected with equipment at the shooting gallery used by these other injectors he may have risked exposure to HIV and have been a vector for HIV transmission to (or from) John (I), R, S and U.

John typically injected at a local park, next to the Brooklyn–Queens Expressway. At this location he and other members of his risk network would congregate to share drugs or food, to help each other inject (if necessary), and to talk about the drug scene, their daily lives, and their hopes for the future.

The index subject of Fig. 2, Sally (F), is a 34-year-old woman of Puerto Rican origin.† She had been injecting for at least 5 years and mainly injected heroin and cocaine mixed together (speedball). Her drug risk network consisted of 8 members, of whom 4 were male and 4 female. She had sexual contact with her lover (P), whom she had known for 3 months (and with whom she had a steady romantic and sexual relationship), and with her landlord (XX)—with whom she had exchanged sex in return for living in his apartment. Sally had only a social connection with 2 other female friends. One of these friends (N) was an injector who did not use drug while in Sally’s presence, while the other (O) sniffs cocaine.

Sally had known 4 members of her drug risk network for more than 5 years (2 of them for 18 years or more). However, Sally had known 3 members of her drug risk network (H, I, and Q) for less than 1 year. Six members of her drug risk network (H, I, J, K, L, and M) had been injecting for 10 or more years while one injector (Q), a 23-year-old woman whom

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*They were a maximal complete subgraph and were completely linked with one another [35].
†The sociograms in Figs 1 and 2 are derived from egocentric network data and, as discussed above, contain limitations. Thus there are some inconsistencies between the reports of F and I, who appear in each other’s sociograms, about their attributes and network links. However, we confirmed through ethnographic observation that F and I in Figs 1 and 2 are the same people.
Social Network Only

Drug Risk Network

INDEX

F
Female, PR, 34
Inj. 5 yrs

Drug injectors' social and risk networks

Fig. 2. Social and risk network of a 34-year-old, female drug injector.

she had just met, 'skin-popped' heroin, i.e. engaged in
venous parenteral injection (Sally did not know
how long her new acquaintance had been doing this).
All members of Sally's drug risk network were Puerto
Rican.
Sally, along with members G, H and I, were a fully
connected clique who 'hung out' together and in-
jected at a local park next to the Brooklyn-Queens
Expressway (as John—member J—also reported).
However, since two clique members (H and I)
attended shooting galleries, this clique may have been
linked to other risk networks whose members were
not in Sally's egocentric network but who attended
the same shooting galleries as H and I. Other
members of Sally's risk network who were not in
the clique, L and M, also attended shooting galleries.
Two female members of Sally's network engaged in
prostitution—one of whom (L) was in her drug risk
network, and the other (Q) only in her social
network. O frequently talked with Sally about what
was happening on the 'stroll' (the area where pro-
stitution took place). One of the women Sally injected
with (K) was her ex-sister-in-law, who did not live in
Sally's neighborhood but who injected with Sally
when she visited Williamsburg.

Interpretation of the case studies

The risk networks in the above two cases exhibit
considerable racial/ethnic homogeneity. However,
they are heterogeneous on a number of other dimen-
sions. Both risk networks include men and women;
members had known the index subjects for varying
lengths of time; and they include both long- and
short-term injectors. If risk networks cut across
gender and the length of time injectors have been injecting
with each other, then social influence and viral trans-
fer among drug injectors may be more likely to occur
between genders and between long- and short-term
injectors than across racial/ethnic boundaries.

Many of the social ties among the network
members are multiplex ties, in which injecting
relationships are between injectors who are also
socially linked through marriage, sexual
relationships, kinship or friendship. Some network members
are also linked through an economic relationship,
with network members engaging together in various
types of economic activities to obtain the resources to
support their drug habits, as well as to provide for
other necessities. Reciprocity between network mem-
bers is common, which indicates that drug injectors
are able to cooperate with each other regarding such
aspects of their lives as providing economic neces-
sities and giving emotional support to one another. In
so far as drug injectors are socially linked with one
another and are able to cooperate with each other, it
may be a basis for developing peer pressure and
support for HIV risk reduction.

The risk networks in the two case studies extend
beyond the direct social relationships which members
have with each other. Attendance at shooting
Fig. 3. Not engaging in risk behaviors in prior 6 months by the percent of encounters which are with non-IDU social contacts.

...galleries by some of the risk network members may increase their risk of exposure to HIV by linking them to anonymous mediated risk networks (through injecting at shooting galleries with rented syringes and other used injecting equipment). Other members in the direct risk networks may in turn have a heightened risk of exposure to HIV because of engaging in risk behaviors with those members who attend shooting galleries.

While drug injectors' direct risk networks commonly include social ties which link network members (some of which may be long-standing, multiplex ties), drug injectors also have social ties with non-injectors. We discuss next how drug injectors' social ties with non-injectors may influence their drug risk behavior.

The influence of drug injectors' social ties with non-injectors on drug risk behavior

The analysis is based on responses from 1100 street-recruited drug injectors who were interviewed for the CAPOD project. Subjects were asked how frequently they had contact with the three relatives they saw most often, and also with their three closest friends or acquaintances, and whether these relatives and friends or acquaintances injected drugs. Subjects were also asked about their own drug and sexual risk behaviors in the 6 months prior to the interview. Among the drug risk behaviors asked about were sharing syringes, attending shooting galleries, sharing cookers, renting syringes, and borrowing syringes.

Almost all (93%) of the subjects had contact with non-injectors (72% with both injectors and non-injectors, and 21% with non-injectors only), while 7% had contact with drug injectors only. (See Table 2.) The mean frequency of monthly encounters (occasions when a respondent 'saw' a relative or 'saw' a friend or acquaintance) with their non-injector contacts (57 times per month) was significantly greater than with their injector contacts (45 times per month, \( P < 0.001 \)). Injectors' encounters with other injectors were predominantly with friends (83% of encounters with other injectors), while their non-injector encounters were mostly with relatives or with a spouse/lover (71% of encounters with non-injectors).

Non-injectors who have social ties with injectors may be able to exert influence on them to adopt safer injection practices. Among injectors in the CAPOD project, subjects with a greater percentage of encounters which were with non-injectors were more likely not to have engaged in specific drug risk behaviors in the prior 6 months. These relationships were significant \((P < 0.01\) or lower) for sharing syringes, injecting at shooting galleries, sharing cookers, renting syringes, and borrowing syringes. (See Fig. 3).

The association between subjects' sharing of injection equipment and the extent to which their encounters were with non-injectors was further examined in multivariate analysis. First, a principal component

<table>
<thead>
<tr>
<th>Table 2. Drug injectors' social contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of IDU status of contacts</td>
</tr>
<tr>
<td>(1) Injecting drug user status of subjects' social contacts</td>
</tr>
<tr>
<td>Only IDU</td>
</tr>
<tr>
<td>Both IDU and non-IDU</td>
</tr>
<tr>
<td>Only non-IDU</td>
</tr>
<tr>
<td>(2) Monthly frequency of encounters by IDU status of social contacts</td>
</tr>
<tr>
<td>Mean (frequency of encounters)</td>
</tr>
<tr>
<td>IDU status of contacts</td>
</tr>
<tr>
<td>(b) Non-IDU contacts</td>
</tr>
<tr>
<td>(3) IDU and non-IDU encounters with social contacts by type of relationship</td>
</tr>
<tr>
<td>IDU encounters ( N = 49,219 )</td>
</tr>
<tr>
<td>Friends</td>
</tr>
<tr>
<td>Spouse/lover</td>
</tr>
<tr>
<td>Other relatives</td>
</tr>
<tr>
<td>Non-IDU encounters ( N = 62,815 )</td>
</tr>
<tr>
<td>Friends</td>
</tr>
<tr>
<td>Spouse/lover</td>
</tr>
<tr>
<td>Other relatives</td>
</tr>
</tbody>
</table>

\*\( P (a - b) < 0.001. \)
analysis was conducted, using a varimax rotation on
the continuous drug-risk-behavior variables. This
generated a ‘sharing injecting equipment’ factor, with
borrowing syringes, renting syringes, sharing a
cooker and sharing syringes all loading above 0.6 on
the factor. This factor, as a dependent variable, was
then entered into a stepwise linear regression, with
forward inclusion at a significance level for entry of
0.05, against the percentage of encounters which were
with non-injectors, race/ethnicity, gender, the number
of years injecting, heroin injection frequencies,
cocaine injection frequencies, as well as opinions about
injecting with used works and pressure from injecting
partners to share syringes. In the final equation,
having a higher percentage of encounters which were
with non-injectors remained significantly associated
with sharing injecting equipment less (P < 0.0001).
(See Table 3.)

The potential role of anonymous risk networks and
shooting galleries in spreading HIV

Although drug injectors’ direct risk networks commonly involve social ties between network
members, their risk networks can also be mediated
and anonymous. Thus, infected syringes, particularly
those which are rented in shooting galleries, can
circulate among injectors who have no direct social
ties with one another. Many of the injectors interviewed
in the CAPOD project had potential ties to
anonymous risk networks. In the 6 months prior to
the intake interview, nearly half (48%) injected at
shooting galleries, while over a quarter (28%) said
they had rented used syringes.

The probability of being connected to an anonymous
risk network and of being exposed to injectors
who are infected with HIV is greater among those
who inject at shooting galleries. Moreover, the likelihood
is thereby increased that HIV may be transmitted
across drug injector risk networks [36–38].

Among injectors in the CAPOD project, those who
injected at shooting galleries, compared to those who
did not, were more likely to have injected with
strangers (22 vs 9%, P < 0.001), rented used works
(41 vs 16%, P < 0.001)—reflecting the commercial
availability of used works in shooting galleries—and
to have borrowed or been given used works (54 vs
34%, P < 0.001).

Injectors who inject at shooting galleries and
similar places where drug users gather to inject drugs,
may, through their ties to anonymous risk networks,
function as a bridge and transmit HIV to members of
their direct risk networks, including those members
who do not attend shooting galleries (as is suggested
by the above case studies from the SFHR project).

Among injectors who were interviewed in the
CAPOD project, 60% of those who injected at
shooting galleries injected or shared injecting equip-
ment with friends or other people they knew, or with
both sex partners and running partners.

Since respondents were asked about their use of
shooting galleries only for the 6 months prior to the
interview, there are insufficient historical data to
determine whether injecting at shooting galleries was
a past risk factor for HIV infection among them.
However, those injecting at shooting galleries had a
tendency toward higher HIV prevalence than those
not injecting at shooting galleries (65 vs 55%,
P < 0.06). This suggests that shooting galleries may
continue to be high-risk injection settings that con-
tribute to the spread of HIV across injector risk
networks. It should also be noted, however, that in
New York City, with a mature AIDS epidemic among
drug injectors, HIV seroprevalence is quite
high although all categories of long-term drug
injectors, regardless of current attendance at shooting
galleries.

IMPLICATIONS FOR FUTURE RESEARCH
AND INTERVENTIONS

In order to understand HIV risk behavior among
drug injectors or to develop interventions, it is not
sufficient to start a priori with the assumption that
the individual injector is always the appropriate unit
of analysis or the appropriate agent and target of
change. A number of the findings presented above
suggest that both analyses of HIV risk behavior
among IDUs and interventions to prevent the spread
of HIV among them need to take into account drug
injectors’ risk and social networks.

Fully 70% of the drug injectors interviewed in the
CAPOD project injected or shared syringes with a
spouse or sex partner, a running partner, or with
friends or others whom they knew. Further, as shown
in the ethnographic analysis of injectors studied in the
SFHR project, the social relationships of drug inject-
ors with members of their risk network were often
based on long-standing, multiple relationships, such
as those based on kinship, friendship, marital and
sexual ties, and economic activity. The intertwining
of drug using relationships with these other social
relationships implies that attempts to reduce HIV risk
behavior among drug injectors may have ramifications for these other relationships, which in turn may either facilitate or hinder the success of such attempts.

Drug injectors also are not cut off from social relationships with non-injectors. The vast majority of those studied, over 90%, had social networks which included non-injectors, particularly relatives and spouses or lovers. These social ties with non-injectors were associated with lower levels of injecting risk behavior, indicating that social relationships with non-injectors may influence HIV risk behavior.

Risk settings may function as institutional forms of risk networks, which is exemplified by the association of injecting at shooting galleries with renting used syringes, borrowing or being given used syringes, and injecting with strangers. At the same time, if behavioral norms in such risk settings can be changed, this may affect the risk of exposure to HIV of those who attend these settings and the subsequent spread of the virus to members of their direct risk networks. Thus, shooting galleries and similar settings, considered as institutional forms of risk networks, can themselves be treated as units of analysis and targets for interventions.

Since a focus on drug injectors’ risk networks and social networks is a relatively new approach for understanding HIV risk, a number of issues require further attention.

One issue is how to mobilize networks for risk reduction. The role of peer pressure and support in influencing risk reduction is well established in the literature [13-18]. Drug injectors’ social ties with other drug injectors are routes through which peer pressure and support can spread. The effective harnessing of peer pressure and support to bring about risk reduction, however, is not always easy to achieve.

One way that has been attempted is through the organizing of drug injectors, either building upon pre-existing social ties among drug injectors or forging new social ties. For example, a major goal of both the CAPOD project in the Williamsburg section of Brooklyn [39-41] and the Twin Cities project in Minneapolis-St Paul [42] was to develop collective self-organization among drug injectors in order to make HIV risk reduction a permanent feature of drug injectors’ subculture.

Since social networks between injectors and non-injectors shape HIV risk behaviors, interventions should be developed which utilize these relationships. Ties between injectors and non-injectors should be encouraged rather than stigmatized.

Conceptually, viewing networks as structures may lend itself to an overly static view of networks. Networks undergo change. Thus, the risk and social networks of the drug injectors with whom ethnographic interviews were conducted over several days in Williamsburg included both long- and short-term members. Since the spread of HIV through networks is also a dynamic phenomenon, it is worthwhile to consider briefly how the dynamic aspects of networks may influence the spread of HIV among drug injectors.

Two types of change in networks may affect the spread of HIV among drug injectors. These are biographical change—which is change at the individual level associated with an injector’s life course or injecting career—and historical change, which is macro-level change occurring within institutions, communities and societies. For example, Friedman et al. [43] found that seroprevalence among new injectors (those injecting 5 years or less) was substantially lower than among those who had been injecting longer (about 20% compared to about 50%). One possible explanation for this difference, based on biographical change associated with the careers of drug injectors, is that as the length of time injectors have been injecting increases, their risk networks broaden to include longer-term injectors who are more likely to be infected with HIV. Interventions may therefore find it valuable to develop methods to target new injectors’ risk networks before they become integrated into the existing drug-injector subculture. Such interventions among new injectors (as well as those at risk of becoming injectors) may shape not only the risk behaviors of this group but may also disseminate risk reduction norms to the larger drug-injector subculture.

An example of historical change influencing the spread of HIV, by re-shaping drug injector networks, may have occurred in the South Bronx. According to Wallace [29, 30], the spread of the epidemic in this area of New York City resulted, at least in part, from a process of ‘urban desertification’, i.e. the contagious physical and social abandonment of urban areas. Neighborhood abandonment not only displaced resident drug injectors (whose serostatus and risk behaviors made them likely disease vectors to populations of injectors and others at risk of HIV infection in other localities), but also broke up pre-existing social networks of the infected and at-risk population, which might otherwise have been used to develop a risk reduction subculture. Such changes in social institutions and societal structures at the macro-level, therefore, may have an impact on drug injectors’ social and risk networks. Future research needs to specify how macro-level changes affect the spread of HIV through drug injectors’ networks. At the same time, interventions among drug-injector networks which seek to prevent the spread of HIV need to take account of the institutional and societal changes which can affect the degree to which they can achieve their goals.

Not the least of the issues which need to be addressed is that of developing appropriate methodologies to investigate drug injectors’ risk and social networks. The investigation and analysis of these networks requires innovations both in sampling design and in implementation in order to reach hidden populations engaging in illegal activities [44, 45]. Advances are also needed in data analysis.
both in computer software for network data base creation and management [46], and in statistical procedure, since a primary assumption behind the use of parametric statistics—namely, that samples are independently and randomly drawn from a sampling frame of a known population—are violated when using various dependent sampling techniques [47]. Given that drug-injector risk networks can quite often be anonymous and mediated, it is also necessary to develop methodologies that do not depend exclusively upon drug injectors' self-reports of their risk networks. For example, investigation of the extent of drug injectors' anonymous and mediated risk networks may require observation and analysis of the composition and turnover of drug-injecting populations in multi-user injection settings.

In conclusion, preventing the further spread of HIV may require, in addition to existing research and interventions directed towards individuals, new research and interventions directed towards the social environment which forms the context for—and which can shape—individual HIV risk behaviors.

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