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Harnessing Peer Networks as an Instrument for AIDS Prevention: Results from a Peer-Driven Intervention

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SYNOPSIS

Objective. Since 1985, community outreach efforts to combat acquired immunodeficiency syndrome (AIDS) among injecting drug users (IDUs) in the United States have overwhelmingly depended on a provider-client model that relies on staffs of professional outreach workers. We report on a comparison of this traditional outreach model with an innovative social network model, termed "a peer-driven intervention" (PDI). The latter provides IDUs with guidance and structured incentives that permit them to play a much more active role in the outreach process, thereby harnessing peer pressure on behalf of human immunodeficiency virus (HIV) prevention efforts.

Methods. We compare the performance of a traditional outreach intervention (TOI) and a PDI that were implemented in medium-sized towns in eastern and central Connecticut. Comparisons are based on the number and representativeness of IDUs recruited at each site, the effectiveness of HIV prevention education, compliance rates with AIDS risk reduction recommendations, and relative cost. The analyses are based on 552 initial interviews and

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190 six-month follow-up interviews conducted during the first two years of each intervention's operation.

Results. Both interventions produced significant reductions in HIV risk behaviors, as measured using self-reports. The PDI outperformed the traditional intervention with respect to the number of IDUs recruited, the ethnic and geographic representativeness of the recruits, and the effectiveness of HIV prevention education. In addition, the costs of recruiting IDUs into the intervention and educating them about HIV in the community was only one-thirtieth as much in the PDI as in the traditional intervention.

Conclusions. The findings suggest that given guidance and nominal incentives, IDUs can play a more extensive role in community outreach efforts than the traditional model allows. The findings also suggest that both interventions reduce HIV-associated risk behaviors, but the PDI reaches a larger and more diverse set of IDUs, and does so at much less expense.

We compare an innovative social network model for accessing injecting drug users (IDUs), called a peer-driven intervention (PDI), to a traditional outreach intervention (TOI), a model that has dominated acquired immunodeficiency syndrome (AIDS) prevention efforts to IDUs throughout the United States since 1985. The latter is based on a provider-client model that relies on professional outreach workers to carry out the following core activities:

- Recruiting IDUs to storefronts for interviews and health services.
- Educating IDUs in the community about AIDS prevention.
- Relocating IDUs for follow-up interviews and further education.
- Distributing risk reduction materials like bleach and condoms.

In contrast, the PDI provides active IDUs with guidance and direct, per-task monetary rewards to carry out within their own drug-using networks the same tasks performed by outreach workers. Based on a multiyear field experiment, we report findings indicating that outreach projects that rely on a direct collaboration with active drug users to access and educate IDUs are effective in reducing IDUs' risk behaviors. Compared with the traditional model, the PDI reaches a larger and more diverse set of IDUs and does so at substantially less expense.

BACKGROUND

Federally funded community AIDS prevention efforts for IDUs in the United States have been based on a provider-client model called street-based outreach.[1,2] In the model, a small number of community members, usually ex-drug users or injectors or people with street credentials, are hired to contact and work with drug-using members of their own community as clients. They do this by going into neighborhoods as outreach workers to distribute AIDS prevention materials and information and to recruit IDUs to various programs and services. Outreach workers are taught to call on IDUs' sense of altruism and give freely of their time and energy to help them combat AIDS, but outreach workers do not offer IDUs any direct rewards or incentives to play more active roles.[3–5]

Research has shown that TOIs suffer from a host of organizational problems that lead projects to drift toward stagnation and invite high levels of malperformance and nonperformance among outreach workers.[6,7] Nonetheless, research also has shown that IDUs' responses to TOIs have been unexpectedly positive. IDUs have been found to substantially reduce their drug-related risk behaviors. IDUs and other drug-scene members have been found to assist outreach workers in carrying out their work and substantially augment the efforts of outreach projects.[6] In the course of doing so, IDUs further disseminated and reinforced prevention norms within the larger drug user community.[8] In short, the response of the IDUs has led many researchers to call for future AIDS prevention efforts that rely on active collaborations with IDUs to harness the power of peer influence and to strengthen IDUs' willingness to help themselves and their community.[9–12] Such a model would draw upon and strengthen the sharing rituals and norms of reciprocity that underlie and sustain social networks among users.[13,14] The basis for such a model is provided by a large and growing number of studies of the social networks of IDUs and others at risk of human immunodeficiency virus (HIV) infection.[15–18]

METHODS

We began operations in eastern Connecticut in March 1994, with a PDI experimental site located in New London and a TOI control site in Windham. Exactly one year later, we were forced to move the experimental site to Middletown because city officials in New London employed local zoning regulations to prohibit further research in that city. At present, Windham's TOI has operated for three years and Middletown's PDI for two years. In this chapter, we compare Windham's TOI and Middletown's PDI based on their first two years of operation.

The Windham and Middletown areas are generally similar, consisting of about a dozen towns surrounding each city. An important finding reported below is the differential success of the PDI compared with the TOI in recruiting IDUs from throughout their respective areas. Based on the 1990 census, the population of the Windham area is 139,900, consisting of 3977 African Americans (2%) and 5422 Hispanics (4%). The population of the Middletown area is 205,500, consisting of 8555 African Americans (4%) and 11,025 Hispanics (5%).

Recruitment into the PDI employs a form of chain-referral sampling that we have termed "respondent-driven sampling" (RDS).[19] It draws on recent developments in snowball and other forms of chain-referral sampling that are designed to overcome the limitations that have traditionally caused chain-referral samples to be seen merely as convenience samples.[20–22]

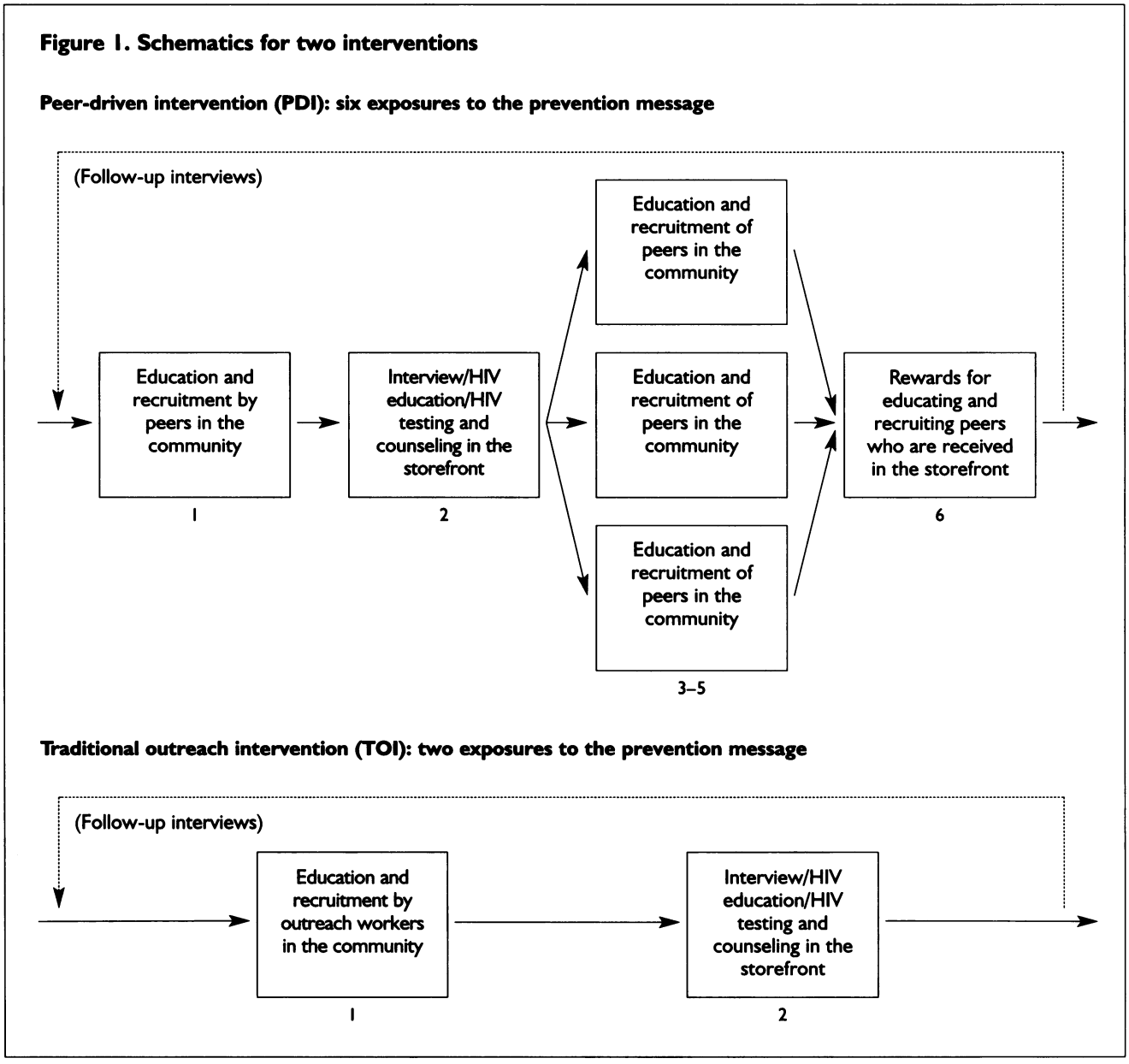
A PDI can be described in comparison to a TOI. As depicted in Figure 1, IDUs' first contact with the PDI occurs when they are educated in the community by the peers who recruit them into the intervention. The second contact occurs when they enter the project's storefront for a session that includes an HIV knowledge test, screening for eligibility for the study, an interview with a health educator, intensive HIV prevention education, HIV testing and counseling, and training in how they can receive rewards by educating their peers in the community and recruiting them to the project. (A much more detailed description of program activities is published elsewhere.[8]) Subjects are given three recruitment coupons and told that they will receive $10 for each injecting peer they recruit into the project. In addition, they are told they will receive up to $10 for educating each recruit, as measured by a brief knowledge test administered before each interview. Thus, each IDU recruiter who recruits and successfully educates three peers can earn up to $60 for working to prevent the spread of HIV in his or her own community. In turn, each IDU who is recruited by a peer also is offered three coupons to recruit still more peers. Thus, as in other forms of chain-referral samples, including snowball samples, recruitment in the PDI has the potential to expand geometrically. Educating and recruiting several peers in the community results in each IDU recruiter repeating the prevention message, which constitute the third, fourth, and fifth points of contact with the prevention message. Finally, when subjects return to the storefront to be rewarded for their education and recruitment efforts, they are debriefed and given another knowledge test—their sixth and final contact with the prevention message. Subjects who return for the six-month follow-up interview are then given the opportunity to repeat the entire cycle.

In contrast, the TOI provides only two points of contact with the prevention message (see Figure 1). The first occurs when the IDU is educated and recruited by an outreach worker in the community, and the second occurs when the IDU goes to the storefront. Activities in the storefront are identical at both the TOI and PDI sites, except that only at the PDI storefront are IDUs trained to educate and recruit their peers in the community. Hence, the differences between the interventions lie in the manner in which IDUs are recruited into the interventions and in what roles they are asked to play after leaving the storefront.

The PDI's incentive system has an unusual feature. Like most research service projects, each participant is paid a primary incentive for agreeing to being interviewed. This is a reward for the person's own behavior. Thus, at both the TOI and the PDI sites, each respondent is paid $20 for an initial interview and $30 for a follow-up interview. The PDI also offers IDUs secondary incentives. These are rewards for eliciting positive responses from their peers, for instance, getting their peers to participate in the intervention and working to ensure that their peers successfully learn a body of information about HIV prevention. Secondary incentives work to strengthen individuals' regulatory interests; that is, their desire to see others behave in certain ways or to change their behavior for their own sake and that of others.[23]

In terms of combating the spread of AIDS, secondary incentives invite IDUs to become personally involved in prevention efforts. (The greater intensiveness of the PDI over the TOI is apparent in Figure 1.) Whereas subjects are passive recipients of services in the traditional model, they are actively involved in the PDI with both community education and recruitment. This difference is reflected in the threefold difference in the number of contacts with the prevention message in the two interventions. Differential

Figure 1. Schematics for two interventions



intensity is significant, because it is a powerful predictor of program impact in a broad array of settings.[24] Finally, the PDI contains all six factors that have been demonstrated to promote behavioral change if they are offered in combination: (1) increases in knowledge, (2) skills building, (3) motivation and incentives, (4) peer pressure, (5) social norms, and (6) repetition. [23,25–28]

RESULTS

In this section, we report on the following sets of results: subject recruitment and education, reduction in HIV risk behaviors, process evaluation, and cost-effectiveness of the two interventions.

The results confirm existing findings that IDUs are capable, responsive, and willing to work to prevent AIDS. The results also support the hypothesis that IDUs can carry out the core activities of community outreach more effectively, and at far less cost, than professional outreach workers.

Recruitment and Education

Recruitment power and diversity. One indicator of the effectiveness of a PDI over traditional outreach is the number and diversity of IDUs recruited for prevention services.

The data reported below demonstrate that the PDI recruitment mechanism is more effective than a TOI and produces a more diverse sample of IDUs.

As reported in Table 1, over the two-year period, the PDI recruited 36% more subjects than did the TOI (317 subjects *vs.* 233). The outreach workers in the TOI were instructed to recruit not merely from within the town, but as broadly as possible. They also were given means of transportation and official encouragement to extend their outreach efforts to the surrounding and more remote areas. Peer recruiters in the PDI were given no special instructions, so their recruitments presumably reflected the geographic extensiveness of their personal networks. The results indicate that the PDI sites drew a more geographically diverse set of subjects, as indicated by the percentage of subjects drawn from outside of town and the surrounding area. In Middletown's PDI, more than one-half (54%) of subjects came from outside the area compared with the TOI's 28% from out of town. Of the PDI subjects, most came from Meriden, which for most subjects involved a 20-minute bus ride and then a 1-mile walk to the PDI storefront. Though the PDI subjects were reimbursed for their bus fares, the difficulty for the subjects in getting to the storefront reflects an impressive commitment to participation in the study; that subjects continued to make this trek during the Connecticut winter makes it even more remarkable.

The PDI works by mobilizing a large and diverse array of IDUs who are already participating in many different drug scenes, some of which may be nonlocal. For example, Figure 2 reports on the subjects recruited to the PDI beginning with a single respondent. Note that recruitment began with an African American male from Middletown who recruited three peers: a white male, an African American male, and a Hispanic male, all of whom were from Middletown. The first white male recruited a female from Middletown whose ethnicity was not determined. However, among her three recruits was a white male who recruited another white male from Middletown, who generated a very large and diverse drug-using network. Note also the even larger drug-using network of subjects, all from Meriden, that was begun by the single Hispanic male from Middletown.

Race and ethnicity of recruits. The racial and ethnic breakdown of subjects also reflects a potential difference in the robustness of the two interventions. Table 2 compares the racial and ethnic distributions of the PDI and TOI samples with the general populations at each site. These comparisons are based on the population distribution within the cities in which each intervention is located rather than within the surrounding area or nonadjacent areas, because the sampling density (the proportion of population members who were sampled) was far higher within these cities.

Ideally, the sample generated by an intervention reflects the racial and ethnic composition of the community, thereby indicating that the intervention reached

Table 1. Geographic dispersion of subjects recruited, first two years of operation

Subject residence	*Traditional outreach intervention (TOI) (n = 233)*	*Peer-driven intervention (PDI) (n = 317)*
Within town	68%	45%
Within surrounding area	4%	1%
Outside of area	28%	54%
Total	100%	100%
Index of qualitative variation (IQV)	0.676	0.760

chi-square = 40.7, df = 2, $P = 0.000$

effectively into each racial and ethnic group within the community. One measure of this difference between the two types of interventions is the mean absolute discrepancy between race and ethnic distribution in the general population in each of the cities in which the interventions were located and in the sample of active IDUs. This figure is larger for the TOI (18.2%) than for the PDI (10.6%), suggesting that a PDI produces samples that are more representative of the community.

Gender and age of recruits. At both sites, male subjects predominate over female subjects by slightly more than two to one (68% in the TOI, 69% in the PDI), and both sites drew subjects with mean ages in the middle to late thirties (37.1 in both interventions). Thus, the two interventions are remarkably similar on these measures.

The effectiveness of prevention education in the community. The effectiveness of AIDS prevention education offered in the community by both IDU recruiters in the PDI and outreach workers in the TOI was assessed using standardized tests consisting of eight items. The results indicated that PDI education was consistently more effective than TOI education.

The mean scores for subjects who were educated by an outreach worker compared with an IDU peer recruiter were significantly different: a mean of 4.8 correct answers in the TOI compared with a mean of 6.4 in the PDI site (see Table 3). This difference is statistically significant.

When IDU recruiters returned to the PDI storefront to receive payment for their efforts, they were again administered the eight-item knowledge test. As described earlier (see Figure 1), one of the strengths of the PDI was

Figure 2. Recruitment network in a respondent-driven sample, beginning from a single "seed"

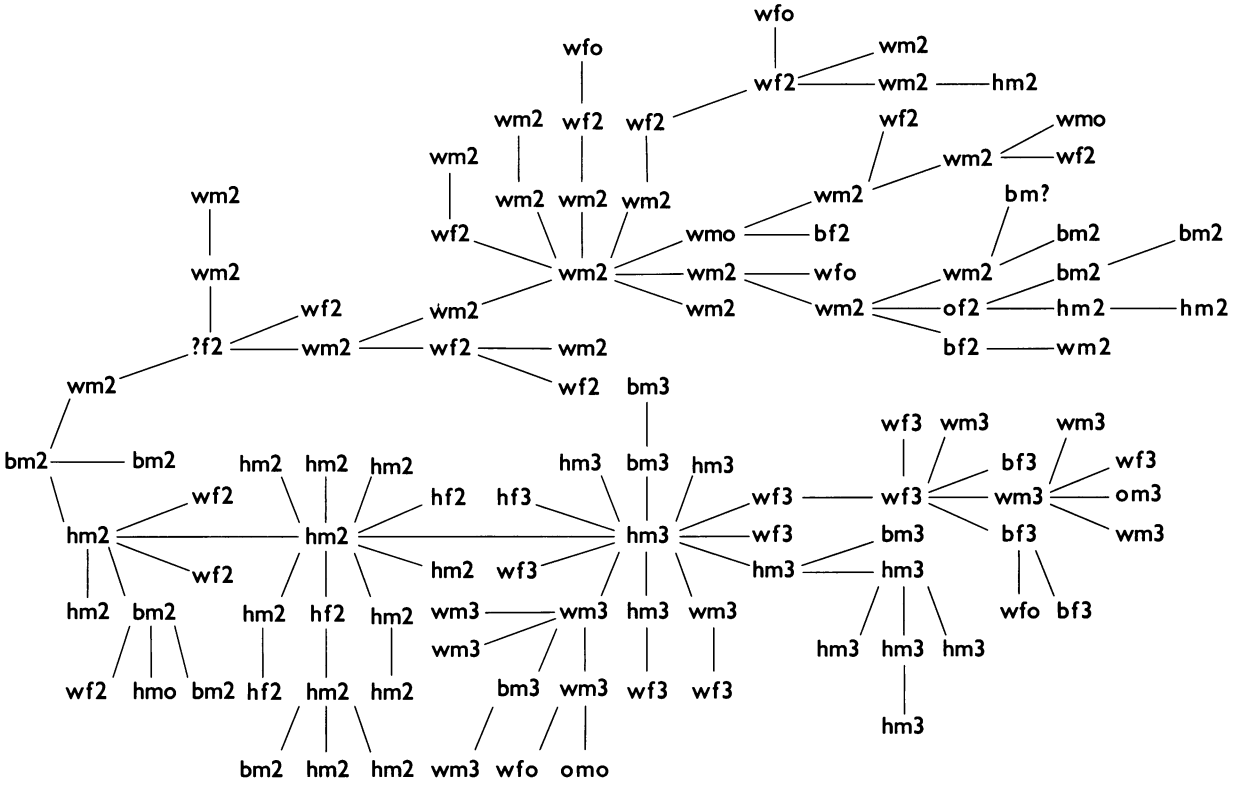


Table 2. Race and ethnicity by site

Comparison of race and ethnicity in each sample and in each site	Traditional outreach intervention (TOI) Sample (discrepancy[a]) (n = 226)	Traditional outreach intervention (TOI) Population (n = 22,039)	Peer-driven intervention (PDI) Sample (discrepancy) (n = 308)	Peer-driven intervention (PDI) Population (n = 42,700)
Non-Hispanic African American	12.4% (+10.0%)	2.4%	11.0% (0%)	11.0%
Non-Hispanic white	44.7% (−36.3%)	81%	64.3% (−21.2%)	85.5%
Hispanic	39.8% (+24.7%)	15.1%	22.1% (+18.8%)	3.3%
Other race	3.1% (1.6%)	1.5%	2.6% (+2.4%)	0.2%
Total	100%	100%	100%	100%
Mean absolute value of discrepancies	(18.2%)		(10.6%)	

[a]The discrepancy is the difference between the sample percent and the population percent.
chi-square = 23.13; df = 3; $P = 0.000$

that the educational component is repetitive, because each IDU can play the role of both student and teacher. IDUs are first educated by their peer recruiter, then by the program staff; finally they repeat what they have learned when educating and recruiting several of their peers. Thus, by the time IDU recruiters returned to the program to receive their secondary rewards—rewards for recruiting and educating their peers—their scores on the knowledge test were significantly higher (see Table 4).

Note that the increase in IDU recruiters' mean scores on the knowledge test after teaching their peer recruits is statistically significant beyond the $P = 0.001$ level. This suggests that the repetitive educational experiences that the PDI entails may lead subjects to higher levels of learning about risk reduction. However, confirmation of this conclusion would require that comparable postintervention contact knowledge tests be administered to nonrecruiters in the PDI and to all subjects in the TOI.

Reductions in HIV Risk Behaviors

This section compares the efficacy of the TOI and PDI in reducing HIV-associated behaviors. The analyses are based on self-reports from an initial interview and one six-month follow-up interview.

Sharing syringes. In the analysis that follows, the Meriden PDI subjects recruited to the Middletown storefront are reported on separately, for several reasons. First, the Meriden subjects' baseline rates of risk behaviors as a group were nearly twice as high as the Middletown subjects' baseline rates. Second, although the towns are only eight miles apart, their drug scenes are almost totally

Table 3. Effectiveness of community-based AIDS education: knowledge test at initial interview ($N = 547$), first two years of operation

Education by site	Mean	Standard deviation
Peer-driven intervention (PDI)	6.4	1.9
Traditional outreach intervention (TOI)	4.8	2.4

T-value = −8.12; df = 545; $P = 0.000$

Table 4. IDU recruiter knowledge test scores ($N = 85$)

Knowledge test	Mean	Standard deviation
Intake test	6.1	1.9
Postrecruitment test	7.3	1.0

T-value = −5.04 (paired differences); df = 84; $P = 0.000$

Table 5. Syringe sharing by site, first two years of operation

Percent reporting sharing behavior	Traditional outreach intervention (TOI)		Peer-driven intervention (PDI)			
			Middletown		Meriden	
	Initial (n = 223)	Follow-up (n = 135)	Initial (n = 149)	Follow-up (n = 60)	Initial (n = 146)	Follow-up (n = 49)
Syringe sharing						
Shared	17.0%	13.3%	12.8%	6.7%	23.3%	20.4%
Did not share	83.0%	86.7%	87.2%	93.3%	76.7%	79.6%
Reduction in sharing	22%		48%		12%	
Chi-square	4.43		7.28		0.035	
df	1		1		1	
Level of significance	0.035		0.007		0.852	

isolated from one another. For example, among the hundreds of peers recruited during the study period, only one involved cross-recruitment: a Hispanic male from Middletown recruited another Hispanic male from Meriden, and this in turn spawned an entirely separate recruitment network and sample from Meriden (Figure 2). Due to the mutual isolation of these two drug scenes, the two towns resulted in distinct PDI samples. Finally, ease of access was quite different for the two towns. The project's storefront was centrally located in Middletown's drug scene. In contrast, residents of Meriden had to ride a bus and then walk a substantial distance to get to the storefront. Therefore, only the more highly motivated Meriden residents took advantage of the intervention.

Table 5 shows the changes in the number of subjects who had shared syringes during the past 30 days at the initial interview and at follow-up.

Both types of intervention reduce the frequency of syringe sharing. The reduction in the number of subjects who share syringes is 22% in Windham's TOI, a change that is statistically significant. Reductions in syringe sharing are variable in the PDI, ranging from a statistically significant reduction of 48% in Middletown to a nonstatistically significant 12% reduction in Meriden.

The results in Table 5 can be compared to benchmarks established by Needle and Coyle in their review of dozens of traditional outreach interventions funded by the National Institute on Drug Abuse (NIDA).[29] Needle and Coyle found that interventions produced between 13% and 43% reductions in syringe sharing, with a median reduction across published studies of 15%. This range is similar to our finding of 12% to 48% reductions reported in Table 5. Furthermore, two of the sites—the TOI and the Middletown PDI—produced statistically significant reductions in syringe sharing that exceed the median benchmark by 22% - 15% = 7% and 48% - 15% = 33%, respectively.

Sharing cookers and filters. Table 6 depicts the change in the mean number of cooker or filter sharings during the past 30 days for each intervention. The results are in some respects similar to that for syringe sharing.

The TOI and the PDI subjects from both Middletown and Meriden exhibit reductions in sharing behavior, but the reduction is statistically significant at only one of the PDI samples. The greatest reduction (76%) occurs in the Middletown PDI, a result that was significant ($P = 0.009$). A lesser (11%), nonsignificant ($P = 0.103$) reduction also occurred in the TOI. A further nonsignificant reduction (6%) occurred in the Meriden PDI. In contrast to the reductions in syringe sharing, the greatest reductions occur at the sites having the lowest baseline cooker- and filter-sharing rates.

These results are mixed relative to the benchmark for reduction in sharing of injection paraphernalia reported by Needle and Coyle.[29] In the dozens of TOI projects they reviewed nationwide, IDUs reduced sharing of paraphernalia by 16% to 35%, with a median reduction across studies of 27%. One of our reported reductions exceeded this median by a substantial amount (76% in the Middletown PDI), but the others fall below it.

Sharing rinse water. Table 7 depicts the change in the mean number of sharing incidents involving rinse water during the past 30 days for each intervention. The results are similar to that for syringe, cooker, and filter sharing in that only one of the PDIs produced statistically significant reductions in the risk behavior. Water sharing falls substantially (60%) and significantly ($P = 0.011$) in the

Table 6. Cooker and filter sharing by site, first two years of operation

Cooker and filter sharing: mean, median, number of incidents	*Traditional outreach intervention (TOI)*	*Peer-driven intervention (PDI)*	
		Middletown	*Meriden*
Initial interview:	13.29	5.30	19.56
Past 30 days	0.0	0.0	0.0
Standard deviation	(43.11)	(17.10)	(44.28)
N	232	145	149
Six-month follow-up:	11.90	1.26	18.49
Past 30 days	0.0	0.0	0.0
Standard deviation	(55.97)	(8.45)	(44.07)
N	135	61	47
T-value	1.64	2.71	-0.7
df (paired T-test with logged frequency)	131	55	45
Two-tailed significance test	0.103	0.009	0.944
Change in HIV risk behavior	-11%	-76%	-6%

Table 7. Rinse water sharing by site, first two years of operation

Rinse water sharing: mean, median, number of incidents	*Traditional outreach intervention (TOI)*	*Peer-driven intervention (PDI)*	
		Middletown	*Meriden*
Initial interview:	12.02	3.51	13.72
Past 30 days	0.0	0.0	0.0
Standard deviation	(47.85)	(13.18)	(38.93)
N	230	144	148
Six-month follow-up:	8.61	1.42	13.98
Past 30 days	0.0	0.0	0.0
Standard deviation	(50.83)	(8.77)	(29.29)
N	127	57	48
T-value	1.04	2.64	-1.41
df (paired T-test with logged frequency)	123	50	46
Two-tailed significance test	0.299	0.011	0.161
Change in HIV risk behavior	-28%	-60%	+2%

Middletown PDI. Water sharing falls by 28% in the TOI, but the change is nonsignificant ($P = 0.299$), and it remained essentially unchanged in the Meriden PDI.

These results also can be compared to the benchmark for reduction in sharing of injection paraphernalia reported by Needle and Coyle.[29] As judged by this benchmark, the Middletown PDI substantially outperformed the dozens of TOI interventions reviewed by Needle and Coyle. Windham's TOI equals the benchmark, but this result may not be meaningful given that the reduction is not significant and the other PDI sample (Meriden) falls below the benchmark reported by Needle and Coyle. Therefore, as with cooker and filter sharing, the performances of the PDIs appear to be mixed.

Frequency of injection. Table 8 depicts changes in injection frequency during the past 30 days for each intervention. The results are mixed. In the TOI, injection frequency increases slightly but significantly (6%, $P < 0.000$).

The results from the PDIs are again inconsistent. Injection frequency decreases by almost two-thirds (64%, $P < 0.000$) in the PDI's hometown (Middletown).

Table 8. Injection frequency by site, first two years of operation

Injection frequency: mean, median, number of incidents	*Traditional outreach intervention (TOI)*	*Peer-driven intervention (PDI)*	
		Middletown	*Meriden*
Initial interview:	85.83	75.10	86.07
Past 30 days	60.0	36.0	84.0
Standard deviation	(120.65)	(235.30)	(53.10)
N	232	150	147
Six-month follow-up:	91.26	27.22	90.53
Past 30 days	24.0	7.0	81.5
Standard deviation	(276.30)	(42.81)	(74.29)
N	151	61	54
T-value	-5.05	-4.93	-1.59
df (paired T-test with logged frequency)	147	57	53
Two-tailed significance test	0.000	0.000	0.119
Change in HIV risk behavior	+6.33%	-63.75%	+5.18%

Table 9. Incidence of unsafe sex by site

Unsafe sex: mean, median, number of incidents	*Traditional outreach intervention (TOI) (n = 127)*	*Peer-driven intervention (PDI)*	
		Middletown (n = 59)	*Meriden (n = 46)*
Initial interview:	9.61	6.54	8.39
Past 30 days	1.0	2.0	4.0
Standard deviation	18.89	8.37	9.95
Six-month follow-up	9.12	7.09	4.49
Past 30 days	0.0	2.0	1.0
Standard deviation	17.9	10.19	6.62
Two-tailed significance (exponential model)	0.010	0.427	0.053
Reduction in HIV risk behavior	42%	20%	45%

There is no significant change in the more remote town (Meriden). Therefore, once again, the Middletown PDI outperforms both the TOI and the Meriden PDI.

Safer sex. Table 9 depicts the incidence of unsafe sex—defined as sex without the use of a condom—during the past 30 days. The mean number of unsafe sex acts was strongly influenced by a few cases with exceptionally high numbers of incidents, many of whom were prostitutes. As a result, the data are strongly skewed in a positive direction. As a result, the mean provides an unreliable measure of central tendency. Hence, ordinary statistical tests, which assume normally distributed variables, are not very powerful for these data. Therefore, the significance levels shown are from an exponential model for incident frequency. We also show the estimated effects of each treatment under the exponential model, which can be understood as multiplicative changes in the predicted rate of injection in a given period of time. Estimated effects are measured by comparing the percent changes in the geometric means of the follow-up and initial injection rates.

A large body of research shows that unsafe sex is a risk behavior that is especially resistant to change. This project's interventions suggest that effective interventions are possible. As assessed using the exponential model, the TOI produces a significant ($P = 0.01$) reduction of 42% in unsafe sex. The results from the Meriden PDI are similar in magnitude, but the result falls just short of significance

($P = 0.053$). The Middletown PDI produces a smaller (20%) and nonsignificant reduction.

Interpreting the impact results. In reflecting on the impact results, a pattern can be seen. With respect to drug-related risks, the PDI consistently outperforms the TOI at its home base in Middletown. With respect to reducing syringe sharing, cooker sharing, rinse water sharing, and injection frequency, the PDI produces reductions that are both greater in magnitude and more significant than those produced by the TOI. However, at greater distances from the home base (in Meriden), the impact of the Middletown-based PDI weakens. The most likely origin of this differential response to the PDI is a proximity effect. First, recall the hurdles that Meriden subjects must overcome to visit the intervention storefront: a 20-minute bus ride and a one-mile walk. These hurdles may have the effect of drawing a special sample of subjects from Meriden; for example, the interviewers characterized the Meriden subjects as "hard core" relative to the Middletown subjects. Similarly, proximity to the PDI storefront confers benefits. Some subjects returned for HIV prevention materials, including condoms and bleach kits, during which prevention messages were reinforced. Such visits are more difficult for nonlocal recruits, and this difference may affect reductions in HIV risk behavior.

How the PDI Works

From process evaluations of the dozens of TOIs funded by NIDA and the Centers for Disease Control and Prevention (CDC) during the past decade, much is now known about how the model functions, including its limitations.[1,2,8] In contrast, our research project constitutes the first implementation of an intervention motivated by ppeers. In this section we examine several questions relating to the peer recruitment and education process that lies at the heart of the PDI. In particular, we report on a comparison of those IDUs who chose to work to combat the HIV epidemic in their own community with those IDUs who did not.

The PDI is not predicated on the proposition that all IDUs are willing to act or are capable of acting constructively as peer educators and recruiters, but on the proposition that these skills are sufficiently available in the IDU community for a peer-based intervention to succeed. It is for this reason that each subject is given three recruitment coupons rather than one; we did not anticipate that every coupon would be used.

Table 10 shows how recruiters differ from nonrecruiters. As is apparent, recruiters differ from nonrecruiters in only two statistically significant characteristics. First, recruiters are more likely to be HIV positive. This may reflect the especially vivid awareness of the ravages of HIV disease among those who are HIV positive. Secondly, recruiters tend to be slightly older. Other factors, such as gender, race, education, and homelessness, do not have significant effects.

Recruiters also differ from nonrecruiters in their HIV risk behavior. Table 11 shows that recruiters consistently engaged in healthier behavior at the initial and follow-up interviews than did nonrecruiters, including lower rates of injection, syringe sharing, cooker and filter sharing, rinse water sharing, and unsafe sex practices. Some but not all of these differences are statistically significant. This suggests that recruiters are drawn differentially from those IDUs with a healthier lifestyle.

From Table 11, it is further apparent that recruiters generally reduce their HIV risk behavior more than do nonrecruiters. For example, Figure 3 depicts the change for unsafe sex. Though the recruiters begin from a slightly higher baseline level of risk behavior than do nonrecruiters, by follow-up time the risk level for recruiters falls steeply. The finding that recruiters generally reduce their risk behavior more than nonrecruiters suggests that the process of participating in recruitment has a positive effect on subjects. In looking again at Table 11, the only exception to the rule that recruiters reduce their risk behavior more than nonrecruiters is that of syringe sharing. This is depicted in Figure 4. As is apparent, the baseline risk level for recruiters is far lower than the baseline for nonrecruiters (2.5 *vs.* 6.2). Therefore, even if the recruiters reduced their risk level to zero, they could not have equaled the reduction among nonrecruiters. However, when expressed as proportionate reductions from baseline, reductions are similar: 84% for recruiters and 81% for nonrecruiters.

Table 10. Recruiter characteristics

	Nonrecruiters	*Recruiters*
Gender (% male)	69	70
Race (% white)	61	66
HIV status (% positive)	7	14[a]
Education (mean)	HS grad or GED	HS grad or GED
Age (mean)	35	38[b]
Homeless at TI/FUI[c]	20% / 6%	29% / 14%

[a] $P < 0.10$
[b] $P < 0.01$
[c] TI/FUI = initial and first follow-up interview, respectively.

Table 11. Differences in baseline and follow-up risk behavior by recruitment efforts

Past 30 days	Mean at initial interview (all)		Mean at follow-up	
	0 Recruits	1+ Recruits	0 Recruits	1+ Recruits
Injection frequency	58 (183)	53 (100)	60 (53)	47[a] (65)
Sharing syringes	6.2 (181)	2.5[b] (101)	1.2 (46)	0.4[c] (49)
Sharing cooker and filters	14.3 (181)	11.8 (100)	16.5 (47)	3.3[b] (53)
Sharing rinse water	12.4 (178)	8.0[c] (101)	12.0 (45)	4.9[c] (43)
Unsafe sex acts	6.9 (180)	7.5 (99)	6.4 (50)	4.7 (60)

T-test
[a] $P < 0.10$
[b] $P < 0.01$
[c] $P < 0.05$

Figure 3. Mean unsafe sex acts at initial interview and follow-up

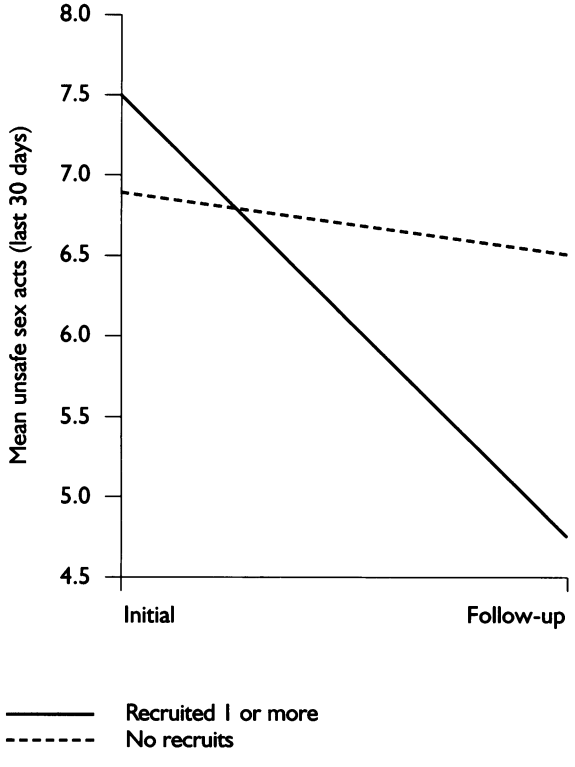
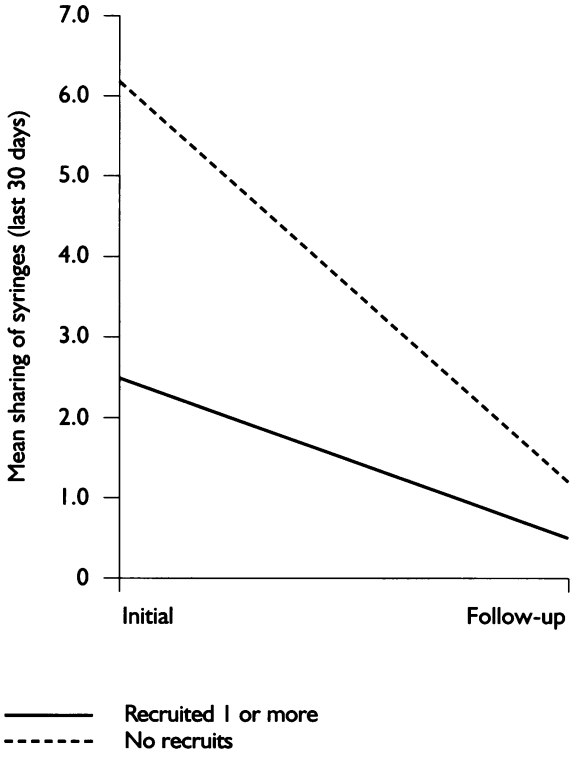


Figure 4. Mean sharing of syringes at initial interview and follow-up



The finding that participation in recruitment serves as an effective means for reducing HIV risk behavior has important implications for AIDS prevention. Many forms of intervention employ peer education and peer influence in some manner, and support groups are an important part of a huge variety of behavioral interventions such as Alcoholics Anonymous (AA) and Narcotics Anonymous (NA). For example, Kelly and associates used social support groups to reduce HIV risk behavior among the mentally ill. Other interventions seek to shape peer influence in the field.[30,31] Other research by Kelly and colleagues that relied on the influence of "key opinion leaders" to alter norms in the gay male community is especially notable.[32] A minority of subjects are trained as opinion leaders, as when especially charismatic individuals in gay bars are trained to educate those in their social circles. Thus, the intervention design takes advantage of existing inequalities of influence in the community.

Designed to shape social influence in the field, the PDI provides every subject with the opportunity to be a peer educator, and many of them respond to the challenge. Hence, a large proportion of subjects ultimately enjoys the benefit of not only receiving peer education but also serving as peer educators. This is particularly significant because when IDUs begin teaching their peers about HIV prevention, they stake some of their reputation on the meaningfulness of what they have conveyed. For them to behave in ways contrary to what they have taught others would make them appear hypocritical.

In sum, the PDI differs from other peer education interventions because it gives all individuals the opportunity to serve as peer educators. This distinction is important because many of the benefits of peer education are derived not only from receiving education from a peer but also from the experience of being an educator. This is consistent with prior research indicating that peer education increases the self-esteem and self-efficacy of the individuals doing the educating.[25–28] The implication for intervention design is that the opportunity to become a peer educator should be as broadly distributed as possible.

Cost-Effectiveness of the Interventions

A recent National Institutes of Health (NIH) Consensus Development Statement noted that little research on the cost-effectiveness of AIDS prevention interventions has been conducted.[29] Table 12 reports the results of our cost comparisons for two activities, community AIDS prevention education and recruitment into the project. The differences in the cost of the two interventions are striking. The rewards paid to peer recruiters in the PDIs ($10 for recruiting a peer and up to $10 for educating the peer in the community) resulted in an average cost of approximately $16 in the PDI. In contrast, the traditional outreach project cost $194,400 for the 24 months involved, consisting primarily of each outreach worker's salary of $2700 per month including fringe benefits and 413 initial and follow-up interviews conducted. This resulted in a cost of $471 per recruit. Thus, the recruitment cost in the PDIs is lower than in the TOIs by a factor of almost 30, quite a dramatic difference in cost.

It is important to note that the above comparison does not include the cost of operating each intervention's storefront, including interviewer and HIV counselor salaries, because these costs are uniform from site to site. Were these two costs to be included, the proportional difference in cost would be substantially reduced. Nonetheless, the results of the cost comparison suggest PDIs may be cost-effective in a setting in which TOIs are impractical. For example, in a cost-benefit analysis, we estimated that a PDI could provide service to the same number of IDUs with 61% fewer staff members and 57% less total cost than would a comparable TOI.[33] Alternatively, were staffing to remain the same, the PDI would serve more than twice as many IDUs (+159%), at only a modest (11%) increase in cost.

CONCLUSION

Overall, the PDI outperformed the TOI in recruitment of a large and diverse set of subjects. In addition, HIV prevention education is more effective in the PDI than in the TOI. There are several reasons why these findings should not be a surprise. First, the PDI puts the burden of identifying IDU recruits on individuals with the best current information: active users. Second, the PDI's pay-for-performance design recognizes and rewards the most productive recruiters. In contrast to salaried outreach workers, the PDI subjects are rewarded in direct proportion to the success of their recruitment efforts; those who recruit no one receive nothing. Third, a PDI offers a built-in accommodation to the cultural diversity in the user

Table 12. Cost evaluation by site

Cost comparison by site (first 12 months)	*Traditional outreach intervention (TOI)*	*Peer-driven intervention (PDI)*
Cost per recruit	$470	$16

population: with IDUs accessing their peers, the recruitment effort is always couched in culturally appropriate terms for each user subgroup. Thus, built into a PDI is a performance-based reward system that continuously adapts to cultural and other subgroup differences.

With respect to the impact on HIV risk behavior, the results reflect a proximity effect. At its home base in Middletown, the PDI outperforms the TOI in reducing syringe sharing, cooker and filter sharing, rinse water sharing, and injection frequency. At Meriden, a more remote location from which subjects were recruited, the PDI had weaker effects. These variations in the performance of the PDI at the two locations point to the need for more research to identify both the contexts under which PDIs operate most effectively and the means by which their performance can be enhanced.

Given that both the PDI and the TOI generally reduce risk behaviors, sometimes to a degree that exceeds benchmark magnitudes, relative cost-effectiveness is important. A PDI is notably less costly that a TOI. This suggests that PDIs may be cost-effective in contexts in which TOIs are impractical, such as cases in which IDUs are geographically dispersed or funds from state and local governments are limited. Public health has traditionally faced stringent budget restrictions and all indications are that, within the foreseeable future, these restrictions will grow. Therefore, it is increasingly important that cost-effective interventions be implemented. The PDI appears to be a big step in that direction.

However, the limitations of this study also must be acknowledged. First, subjects were not randomly assigned to the two treatment conditions. Though this would not have been practical, given that the TOI and PDI constitute alternative means for recruiting and thereby selecting subjects, the lack of randomization in a quasi-experiment introduces the potential for bias resulting from differences among the study sites. Second, as is typical in AIDS prevention research, intervention impact was assessed using self-report data. Third, attrition rates were relatively high, and the sample size was modest. Hence, definitive conclusions must await further studies.

In conclusion, let us consider the manner in which lessons from both the PDI and the TOI might be combined to produce a composite intervention that incorporates each model's best features. In comparing the performance of outreach workers in a TOI with peers in a PDI, it must be recognized that they engage in somewhat different tasks. Outreach workers are not only engaged in community AIDS prevention education and recruitment, other activities—case management, referrals of clients to community agencies, and presentations to different community groups—frequently consume much of their time. It is difficult to envision how these activities could be undertaken by peers. Therefore, even where PDIs are adopted, it is important that these services continue to be offered. Furthermore, a PDI requires a staff to operate the incentive system, educate subjects recruited into the intervention, and provide HIV-test counseling. These also are tasks for which individuals hired as outreach workers are well suited. Therefore, even though a PDI removes certain tasks from outreach workers (especially locating, relocating, and educating IDUs in the community), other important tasks remain that need to be performed.

A potential benefit of this reallocation of outreach workers' labor is that it would help to insulate them from the occupational risks of street-based outreach work.[7] These include the danger of addiction relapse that arises when recovering drug users are asked to enter active drug scenes and develop trusting relationships with active injectors, the danger of violence in such settings, and the temptation to become involved in the many different black-market activities that occur on the street. In an effort to reduce these hazards, many interventions require that outreach workers operate in pairs, a practice that further reduces an intervention's efficiency while only partially resolving the above-mentioned problems. If a TOI is combined with a PDI, the outreach workers would become health educators. As such, they would be assigned to a storefront where they could be supervised effectively and where they would practice far more efficiently in providing risk reduction services to the peer-recruited IDUs who come to them.

The transition from a TOI to an integrated intervention could be undertaken in a straightforward manner. It merely requires a staff of outreach workers redeployed as health educators to recruit a handful of IDUs to serve as "seeds" to begin a peer recruitment process. The health educators would then oversee the PDI incentive system and be responsible for carrying out the programmatic tasks described earlier that are essential to AIDS prevention—HIV-test counseling, prevention education, referrals to other services, and presentations in the community. In this way, PDI principles could be integrated into a traditional intervention that would require a smaller staff while at the same time being significantly more efficient and effective at far less cost. As thus conceived, a PDI is not a replacement for street-based outreach activities. It calls for an enhancement of outreach workers' talents by economizing and reallocating their labor and for future

prevention efforts that entail a working collaboration with IDUs to carry out the core tasks for which they are best suited—locating and educating their peers in the community about AIDS.

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