

**HIV Risk Among Out-of-Treatment
Drug Users:
A Cluster Analysis of the NIDA AIDS
Outreach Cooperative Agreement.**

Michael L. Dennis, Ph.D.,

Chestnut Health Systems, Bloomington IL U.S.A.,

Wendee M. Wechsberg, Ph.D.,

Research Triangle Institute, RTP, NC U.S.A.,

Randolph R. Rasch, Ph.D.,

University of North Carolina, Chapel Hill, NC U.S.A.

Poster (14276) presented at the 12th World AIDS Conference, Geneva, Switzerland, June 28-July 3, 1998.

(An adobe copy of this poster can be downloaded from www.chestnut.org/files2, filename: WAC98TXT.PDF)

Abstract

Objectives: To a) identify subgroups of out-of-treatment drug users who have similar patterns of HIV risk behaviors, b) examine how the demographic characteristics vary by HIV risk group, HIV status and changes in behavior, and c) discuss the implications for program planning.

Design: Prospective longitudinal survey across 18 HIV demonstration sites in the U.S.A.

Methods: The data for this presentation come from two random quarters (Q1 and V1) of the 12/94 national cross-site data, each of which includes data from 18 sites on approximately 4500 injection and crack users. All clients completed questionnaires, urine tests, and HIV tests at intake and six months later. The results were also replicated with an independent sample of over 500 people from the North Carolina site. In all three samples, only people with either positive OnTrak urine tests for opioid or cocaine or visual needle tracks were included, and people who had been in treatment during the past 30 days were excluded. Over 250 self-reported questions on current behavior were collapsed into 20 conceptual scales of HIV risk behavior related to substance use, needle use, sexual behaviors and combined drug-sex behaviors. These scales were then collapsed into 4 orthogonal factors and Ward's minimum distance methods was used to empirically cluster these 8 subgroups in this geometric space.

Results: Individual Risk Group was able to explain 55.9 to 82.3% of the variance in the 4 statistical dimensions at intake (99.6% of their joint distribution) and 12.8 to 36.4% of the variance at follow-up (62.8% of their joint distribution). It was significantly related ($p < .0001$) to participant characteristics, HIV status, site, and follow-up rates. The results were replicated in both the other random sample and the subsequent independent sample. Failure to consider subgroups diminished or washed out numerous large effect sizes..

Conclusion: HIV risk behaviors are very heterogenous among out-of-treatment drug users and should be considered in targeting outreach, designing interventions, and evaluating them. Use of risk subgroups can focus the evaluation findings and dramatically improve statistical power.

Introduction and Background

Outreach and intervention with out-of-treatment drug users in their natural communities has been a major part of our national HIV/AIDS-prevention strategy for over a decade (ASTHO, 1988; Centers for Disease Control [CDC], 1987; Coyle, Boruch, & Turner, 1989; Turner, Miller & Moses, 1989; Watkins et al., 1988). Since the beginning intervention design and evaluation have been complicated by several issues, including: a) a rare population that is engaging in illegal activity, b) the rare and sensitive nature of many HIV risk behaviors, and c) heterogenous risk behaviors. The objectives of this paper are to: a) empirically identify the major HIV risk groups among drug users in the community, b) examine how these risk groups are related to demographics, interactions with others, risk behaviors and community, and c) evaluate the prognostic significance of these risk groups in terms of future risk behaviors. We will also look at some of the methodological implications of these finding for future community-based interventions and evaluations.

From the Closet to One of the Leading Causes of Death. According to the National Center for Health Statistics (Anderson, Kochanek & Murphy, 1997), Acquired Immune Deficiency Syndrome (AIDS) is now the eighth leading cause of death across all ages (16.4/100,000) and the leading cause of death in people aged 25-44 (36.9/100,000). Among males aged 25-44, it is the leading cause of death overall (61.7/100,000) and significantly higher among black men (182.0/100,000). Among females aged 25-44 it is the third leading cause of death (12.3/100,000) and the leading cause of death among black women (54.4/100,000). Of the people with AIDS in 1997, the Center for Disease Control (CDC) (1997) attributed the infection to injection drug use for 34% of the males, 32% of the females, and (indirectly) 35% of the pediatric cases. But even this may grossly underestimate the role of drugs and AIDS. CDC's traditional risk factors did not cover 20% of the males, 28% of the females, or 35% of the pediatric cases. This problem of unattributed risk is even worse for the Human Immunodeficiency Virus (HIV) that is presumed to cause AIDS; no risk was identified for HIV in 36% of the males, 50% of the females, and 11% of the pediatric cases (plus another 22% where the mother's risk did not fit). Further investigation of these unclassified cases by CDC allowed for less than half to be classified into one of the current categories; of those that could be classified, another 27% were attributed to injection drug use.

A Decade of HIV Outreach to Drug Users. Early on sharing needles as part of drug use was recognized as a major route of transmission (Watkins et al., 1988). Between 1988-1998 the National Institute on Drug Abuse (NIDA) has sponsored over a decade of quasi-experimental and experimental studies to develop, evaluate, and better understand how to do HIV outreach to drug users. These studies have demonstrated the effectiveness of using indigenous outreach workers, education, testing and counseling, treatment coupons, bleach distribution, condom distribution, aversive video tapes, motivational interventions, case management and other referrals in reducing HIV risk behaviors among out-of-treatment drug users (Amsel, 1990; Anderson, Hockman, & Smereck, 1996; Booth, Crowley, & Zhang, 1996; Brown, Beschner, and the National AIDS Consortium, 1993;

Coyle, 1993; Deren, Davis, Beardsley, Tortu, & Clatts, 1995; Leukefeld, Battjes, & Colon, Sahai, Robles, & Matos, 1995; McCoy et al., 1996; Rhodes & Malotte, 1996; Stephens et al., 1993; Stevens, Tortu, & Coyle, 1998; Trotter, Bowen, Baldwin & Price, 1996; U.S. Department of Health and Human Services, 1994; Wechsberg & Cavanaugh, in press; Wechsberg, Dennis & Stevens, 1998; Weeks et al., 1996; Wiebel et al., 1996;). In a recent review of 36 HIV outreach studies to drug users, Needle and Coyle (1997) found that the median effects were: a) 26% more people stopped injecting, b) 28 had fewer average injections per month, c) 15% less people shared needles, and d) 27% less people shared cookers and cotton. The majority of studies that looked at the issues also found reduced rates of other risky needle practices and risky sexual practices, as well as, increased rates of needle disinfection, entrance into substance abuse treatment, and condom use.

Towards an Expanded Model of HIV Risk Among Drug Users. As we learn more and more about drug use we have come to realize that needle use is a very imperfect measure of HIV risk among drug users. Not only is it relatively rare among drug users in the U.S., but most needle users are not sharing their needles (the presumed mechanism of transmission) (OAS, 1997). It is, therefore, useful to offer a brief reprise of multiple ways in which drug use may potentially be related to HIV transmission based on prior research (Blattner, et al., 1985; CDC, 1995, 1996; Des Jarlais & Friedman, 1987; Dwyer, et al., 1994; Friedland, et al., 1985; Inciardi, 1994; Joe & Simpson, 1995; Jose, et al., 1993; Koester, 1994; Koester, Booth, & Wiebel, 1990; McCoy & Inciardi, 1995; Longshore & Anglin, 1995; Stall & Leigh, 1994; Wechsberg & Cavanaugh, in press; Wechsberg, Dennis & Stevens, in press; Wechsberg, Dennis, & Ying, 1995; Wechsberg, et al., 1997). These include: a) direct transmission via blood from needle sharing, b) indirect transmission via works or rinse water, c) impaired judgement about sexual partners and contraception use, d) short-term physiological effects to allow longer sex (resulting in increased abrasions), e) psychological issues such as overcoming pain or inhibition, f) long-term physiological effects including dependence that may weaken the immune system, increase the probability of an STD and, consequently, increase the probability of HIV transmission during any given exposure, g) trading sex to get drugs (or drugs to get sex) which increases the risk for the number of partners, h) peer networks for sexual partners that include many high-risk people, and i) limited access to care that may lead to higher rates of physical and mental distress that can also increase the likelihood of transmission.

The Search for Empirically Defined HIV Risk SubGroups Among Drug Users. As the number of studies showing gender, race, geography and a variety of other differences between drug users continued to grow, there was increasing interest among the participants of the second cohort in doing multi-site analyses. Despite seemingly rigorous selection criteria (discussed further below), there were considerable differences between sites. In 1995, a methodological committee was, therefore, formed to attempt several different approaches to cluster analysis in an attempt to empirically identify risk subgroups among drug users. There are actually numerous approaches to cluster analysis (Aldenderfer & Blashfield, 1984; Anderberg, 1973; Rapkin & Luke, 1993; Ward, 1963). The three approaches to clustering that were examined by this committee included Ward's minimum distance (this paper; Dennis & Wechsberg, 1996), k-clusters (Williams et al., in press), and latent class analysis (Abdallah et al.,

1996). While somewhat similar, the solutions are different. The Ward's method used here is designed to identify homogenous clusters. It is more likely to find several small subgroups of outliers where the other two methods tended to collapse them into larger groups. We prefer this approach because these small subgroups represent the "highest risk" subgroups that are 5 or more standard deviations away from the other more common subgroups and because they have very different profiles. The analysis presented here is also different because it used almost 10 times the number of variables to derive the clusters and has been evaluated in terms of its predictive validity and replicability.

Methods

Data Sources and Sample Selection Criteria. This paper is based on the December 1994 NIDA cooperative agreement data set which includes cross-site data from 19 of the 23 sites. To be included in the study, an individual had to a) provide informed consent, b) be over 18, c) have been out of treatment for at least 30 days, d) self-report injection or crack drug use, and e) have either visible needle tracks or a positive urine test for opioids or cocaine. Since this target group is relatively “hidden and elusive,” clients were recruited using variants of snowball sampling (Carlson et al., 1994; Watters & Biernacki, 1989) combined with quotas based on drug-use patterns and geography. The main data set used in this analysis is a random sample constituting a quarter of the cases in the full data set. It is also cross validated against a second randomly selected quarter of the same data set and subsequent data from the North Carolina site that was not in the original data set (i.e, a pure replication). As per the agreement of the cross-site methods committee, the remaining half of the national data was not used so that alternative models or approaches to validation could be attempted by others.

Sample Characteristics. Demographically, the sample of out-of-treatment drug users (n=4,445) was predominately male (70%), Black (57%) or Hispanic (21%), likely to be single (45%) or separated/divorced/ widowed (33%), and ages 25-44 (79%). During the prior month, 32% had been homeless, 19% employed, and 8% arrested. Reporting lifetime needle use were 63.85%, with 60% reporting use in the past month. During the past 30 days, 59% reported using crack, 46% had a single partner, 30% had multiple sexual partners, and just over 1% were men who had sex with men.

Instrumentation. Data were collected between January 1992 and June 1994 using NIDA’s Risk Behavior Assessment (RBA), the Risk Behavior Follow-up Assessment (RBFA) at six months, On Track urine tests for cocaine and heroin, ELISA for HIV antibodies, and Western Blot for confirmation of sero-positivity. Study procedures have been described at length elsewhere (Dowling-Guyer et al., 1994; Weatherby, et al., 1994; Wechsberg & Cavanaugh, in press). The RBA/RBFA questionnaires used across sites each take about 40 minutes and cover 10 domains: demographics, drug use, drug injecting, drug use-last 48 hours, drug treatment, sexual activity, sex for money or drugs, health, arrests, and work income. It has previously been shown to produce acceptable (test-retest of 0.7+) levels of reliability and concurrence with urine tests (Weatherby et al., 1994). Cocaine and opioid urine analysis was done on site with Roche Diagnostic System’s OnTrak (TM). This is a self-contained assay unit employing a sensitive latex agglutination system that reports a positive when substance concentrations exceed NIDA recommended cut-offs and are highly correlated (.98) with the more reliable and expensive gas chromatography.

Data Preparation. In general, all legitimate skips and not applicable consistency codes were recoded to their implied values of 0/no/none. All data that was out of range or marked “don’t know”, “refused”, or “missing” was set to missing. The sexual practice questions in the RBA/RBFA have a complicated skip pattern and different variable names

based on the respondent's gender and the gender of their sexual partners. We, therefore, created a single set of summary measures for four potential types of sex that were asked about (anal, cunnilingus, fellatio, vaginal) by whether the respondent was the primary agent providing fluids in the act or the primary person receiving them (which was presumed to be related to the probability of transmission). Because of how the questions are worded, this means that the agent is the man inserting his penis in anal sex, the woman receiving oral sex in cunnilingus, the man receiving oral sex in fellatio, and the man inserting his penis in vaginal sex. In terms of reception, this would be the person into whose rectum the penis is inserted during anal sex, the person performing cunnilingus or fellatio, and the male inserting his penis in vaginal sex. Finally, for each type and direction of sexual activity we created three summary measures: frequency of the behavior, frequency of using protection during the behavior and the ratio of the two (i.e., protective frequency/frequency). Thus, we had 24 sexual practice measures (4 types of sex X 2 directions of fluid passage X 3 measures). Where the behavior was not possible because of gender or lack of appropriate partners, we set the frequency and protection measures to "0" and the ratio of protection to "1" (i.e., no sex is the best possible protection).

The median of the valid data was then determined and used to replace the missing data for individual questions. The median was used (instead of the mean) because most of the question responses were moderately to sharply skewed. Less than 3% were missing on any question, and in all but a few instances fewer than 15 out of 4445 (>1%) cases were missing. For the number of male and female sexual partners, replacement was done within gender. For replacement of questions related to the frequency of sexual activities, replacement was done within current (past 30 days) sexual pattern. This was defined as a) celibate, b) males having sex with females, c) males having sex with males and females, d) males having sex with males, e) females having sex with males, f) females having sex with males and females, and g) females having sex with females.

Scale Construction. In this kind of community-based research, it is common for answers to conceptually-related questions to go in different directions (e.g., a woman says she is not a prostitute but does trade sex for drugs; a man says he is not gay but does have sex with other men). These are real differences in peoples' self-perceptions, not simply measurement "errors." The analysis here, therefore, used 20 "conceptual" indices of HIV risk behaviors developed by combining similar items. We developed these indices by: a) dividing the RBA/RBFA questions into four domains (substance use, needle use practices, sexual practices, combined drug-sex risk behaviors); b) focusing on current (past 30 days) behaviors that are measured both at baseline and at six-month follow-up and were capable of measuring change; c) identifying groups of three or more questions related to the same "concept;" d) verifying that at least 1% of the respondents reported the behavior; and e) testing to make sure that the items in a given index were correlated with the other items (0.2 or more) and internally consistent (alphas of 0.7 or more).

For several variables, we had to dichotomize extremely skewed distributions or convert to z-scores prior to summations because of differences in scale and distribution (e.g., days of

use, times of use, any use in the past 48 hours). The sum of such z-scores is “variance weighted,” giving greater weight to “rarer” behaviors (which in this questionnaire are also more risky). While these sums have a mean of 0, their variance actually ranges from the number of items in the scale (k) to the number of items squared (k-squared). In the case of sexual practice, we used factor-based scales to create orthogonal measures of frequency and frequency of protection (which are in practice actually highly correlated). All indices were then standardized (mean=0, variance=1) and five (needle cleaning, needle risk reduction, male protective sex, female protective sex, sexual risk reduction) were reversed so that in all of the indices, positive values mean “higher risk” and negative values mean “lower risk.” Table 1 in the appendix summarizes the four domains, the 20 conceptual indices, their Cronbach’s coefficient alphas (which is the lower bound of their reliability and the percent of variance of the items explained by a their first principal component), and the items on which they are based. Note that four of the measures vary almost exclusively among men (Male Sexual Pattern Frequency Index, Male Sexual Pattern Protection Index, Anal Agency Risk Index, and Purchasing Sex Risk Index) and three different measures vary almost exclusively among women (Female Sexual Pattern Frequency Index, Female Sexual Pattern Protection Index, and Trading Sex Risk Index). The Anal Receptivity Risk Index had variation among both males having sex with males and among females.

Identification of Risk Subgroups. We developed and evaluated our empirical typology of HIV risk groups in several steps. First, we did a factor analysis with an alpha method and a varimax rotation to collapse the 20 conceptual measures into four orthogonal dimensions. The number of factors was selected based on multiple criteria including: visual inspection of the scree, eigen values greater than 1, 3 item loadings of at least .4 on each (rotated) factor, and the presence of every scale in at least 1 dimension. Six factors had eigen values of 1 or more, however we focused on the four factors for which all of the other criteria converged. We labeled the 4 dimensions resulting from this analysis as: primary needle user pattern dimension (PNUPD), primary crack user pattern dimension (PCUPD), male alcohol and sex pattern dimension (MASPD), and female drug and sexual pattern dimension (FDSPD) described further in Exhibit A of the Appendix. Unlike the conceptual scales which go from low to high risk, these dimensions are better thought of as geometric coordinates. At one end of the primary needle user dimension, for instance, are high frequency needle users who share; while at the other end, the two main groups of crack users, while they do not use needles, are not low risk either.

Second, we conducted a cluster analysis using Ward’s (1963) minimum distance on the four dimensional factor scores. The number of groups (8) was selected based on multiple criteria including: visual inspection of the dendrogram, (cluster) eigen values greater than 1, and initial groups of 5% or more, a cluster solution that explained at 99% of the variance in the joint distribution (based on 1-Wilks Lamda) of the factors and replicable equations. We allowed discrete groups of less than 5% to be identified if they were 1 or more standard deviations away from the centroid of the next nearest group - the three resulting groups were more than 5 standard deviations out and in three different directions.

Third, we profiled each of the resulting groups based on the four dimensional factor scores, the results of their HIV tests, a variety of demographic variables, the 20 conceptual risk measures, and their communities. We then brought together the core clinical and research team to review and interpret the profiles like a clinical case conference.

Fourth, we evaluated the validity of the cluster solution in multiple ways, including a) reverse validation (i.e., predicting the source variables from the cluster solution), b) predictive validity (i.e., examining the extent to which the cluster solution predicts future risk behaviors), c) cross-validation (i.e., seeing if the above results would be replicated in the second random sample from the national data), and d) replication on new data sets (Classification of future cases discussed in Exhibit B of the Appendix).

HIV Risk Groups in Out-of-Treatment Drug Users.

Our cluster analysis of the sample of 4,445 out-of-treatment drug users from 19 sites suggested eight main HIV Risk Subgroups. The labels we have assigned to these groups and their prevalence are:

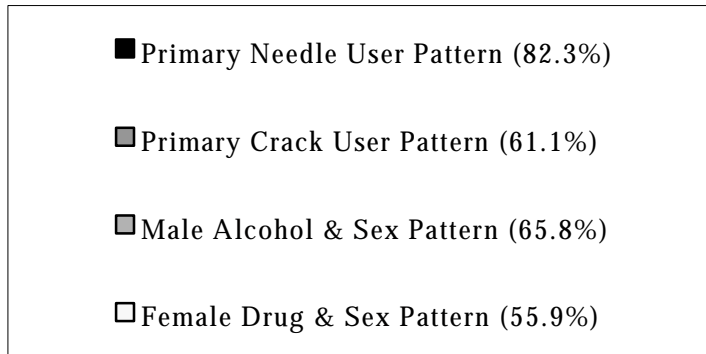
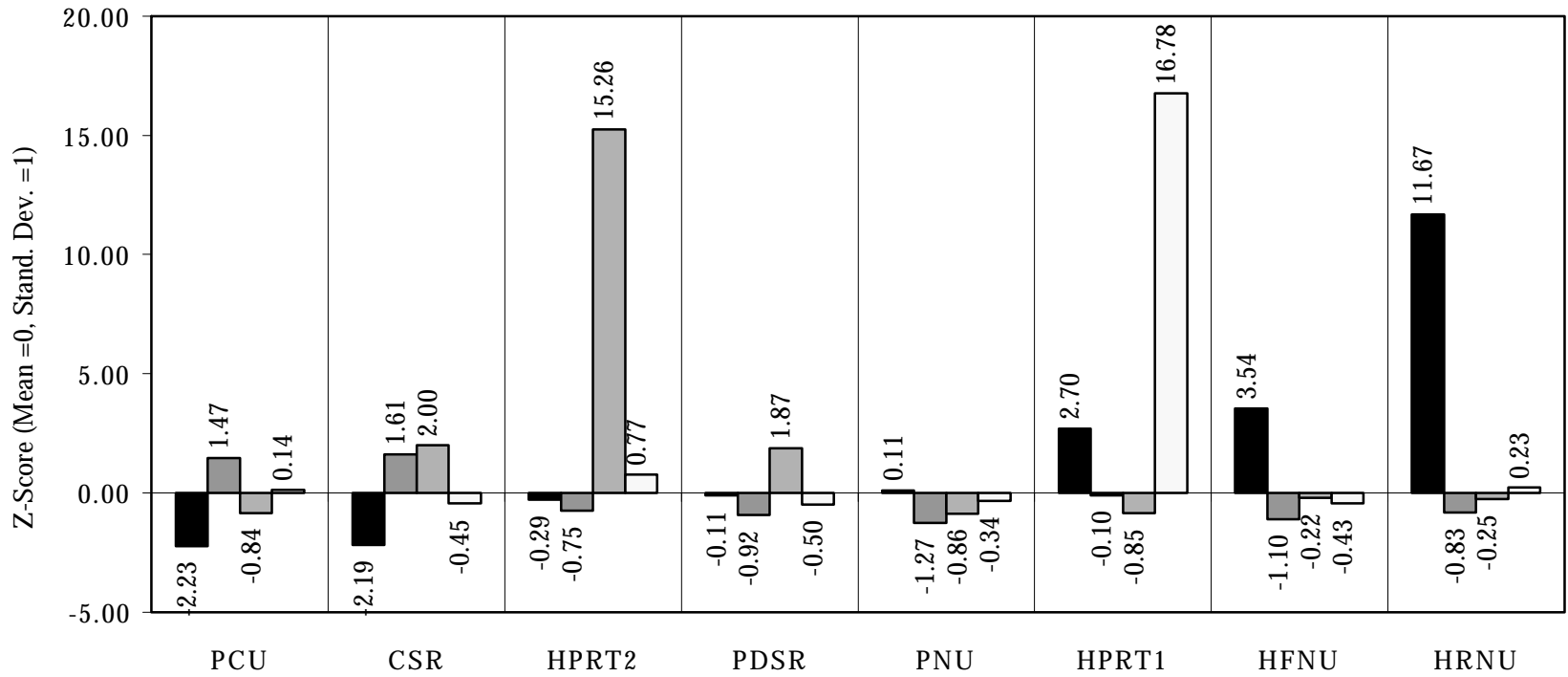
PCU	Primary Crack Users (29.2%),
CSR	Crack/Cocaine and Sexual Risk (12.8%),
HPRT2	High Poly Risk Type 2 (0.3%),
PDSR	Poly Drug and Sexual Risk (10.9%),
PNU	Primary Needle Users (24.1%),
HPRT1	High Poly Risk Type 1 (1.3%),
HFNU	High Frequency Needle Users (19.8%),
HRNU	High Risk Needle Users (1.6%)

Figure 1 shows the distance of the mean (or center) for each of the eight risk groups from the total mean expressed as a z-score (mean of 0, standard deviation of 1) for each of the 4 orthogonal dimensions. While they are small in size, notice how HPRT2, HPRT1, and HRNU are all more than 10 standard deviations away from the rest of the drug users and in three different dimensions. Next notice how as one moves from left to right the scores on the needle user dimension increase and the scores on the crack user dimension decrease. The two high poly risk groups are engaged in trading sex for drugs, with type 1 being women trading sex to get drugs or money and type 2 being men trading drugs or money to get sex. Though several orders of magnitude lower, note that the CSR and PDSR subgroups are also predominately males trading drugs or money for sex.

Figure 2 compares these subgroups of drug users in terms of their rates of HIV testing and seroprevalence. Overall 10% tested positive for HIV and 15% went untested. The seroprevalence rates varied significantly ($\chi^2_{(7)}=122.44$, $p<.0001$) from 6-9% for the non-to-low frequency needle using groups up to 15-18% in the higher frequency needle using groups and 24% in high risk (needle sharing) group. By way of comparison, the CDC (1998, p. 38) reports that there are approximately 327,108 adults currently living with HIV or AIDS in the U.S. (CDC, 1998). While the CDC believes that this is an undercount, it would be the equivalent of a seroprevalence rate of 0.1% and is less than 1/100th of the overall rate in our out-of-treatment drug users, and less than 1/90th the rate of the largely “non-needle using” primary crack user subgroup (which is also presumed to be a lower bound estimate since 15% were not tested). While it would be commonplace to collapse the three smallest groups into their nearest neighbor, from a program planning and policy perspective, it is important to note that two of these small groups have the first (HRNU) and third (HPRT1) highest rates of HIV seroprevalence and two have the first (HPRT2) and second (HPRT1) highest rates of being “untested.” Thus, while work may have to be more qualitative with these smaller groups, they may represent a very promising rate of return in managing the total risk of this population.

The risk groups were also significantly related ($p < .0001$) to demographics (gender, race, age, education) and major status variables (marital, housing, employment, and criminal justice status) and simple risk factors (needle use history, substance use pattern, sexual partners, current sexual activity) as well as the 20 conceptual measures of HIV risk behaviors. Figures 3-6 profile the eight risk groups of drug users in terms of the original 20 indices related to substance use, needle use, sexual activity and multi-risk behaviors. Like Figure 1, they show the deviation of each group from total mean expressed as a z-score (mean of 0, standard deviation of 1). Recall that the direction of positive scales (e.g., cleaning needles, using protection during sex, risk reduction) were all reversed so that higher numbers always mean higher risk and lower numbers always mean lower risk. The percentage of variance explained in a scale by the risk group variable is presented after the name of each scale. Again, all are significant, with the probability of Type 1 error being less than .0001. This is largely an artifact of the large sample size and they actually vary considerably in terms of the percentage of variance explained by the subgroups (discussed more under “validation” later). Below are brief descriptions of each of the eight subgroups, including a discussion of these profiles.

Figure 1. Location of Clusters in 4 Dimensions of HIV Risk Behaviors



Notes: Shows deviations from total mean in 12/94 NIDA AIDS outreach data set. Percent of variance explained in parantheses are all significant at alpha less than .001. Groups are Primary Crack Users (PCU), Cocaine and Sex Risk (CSR), High Poly Risk Type 2 (HPRT2), Poly Drug and Sex Risk (PDSR), Primary Needle Users (PNU), High Poly Risk Type 1 (HPRT1), High Frequency Needle Users (HFNU), and High Risk Needle Users (HRNU).

Figure 2. HIV Status by Risk Group

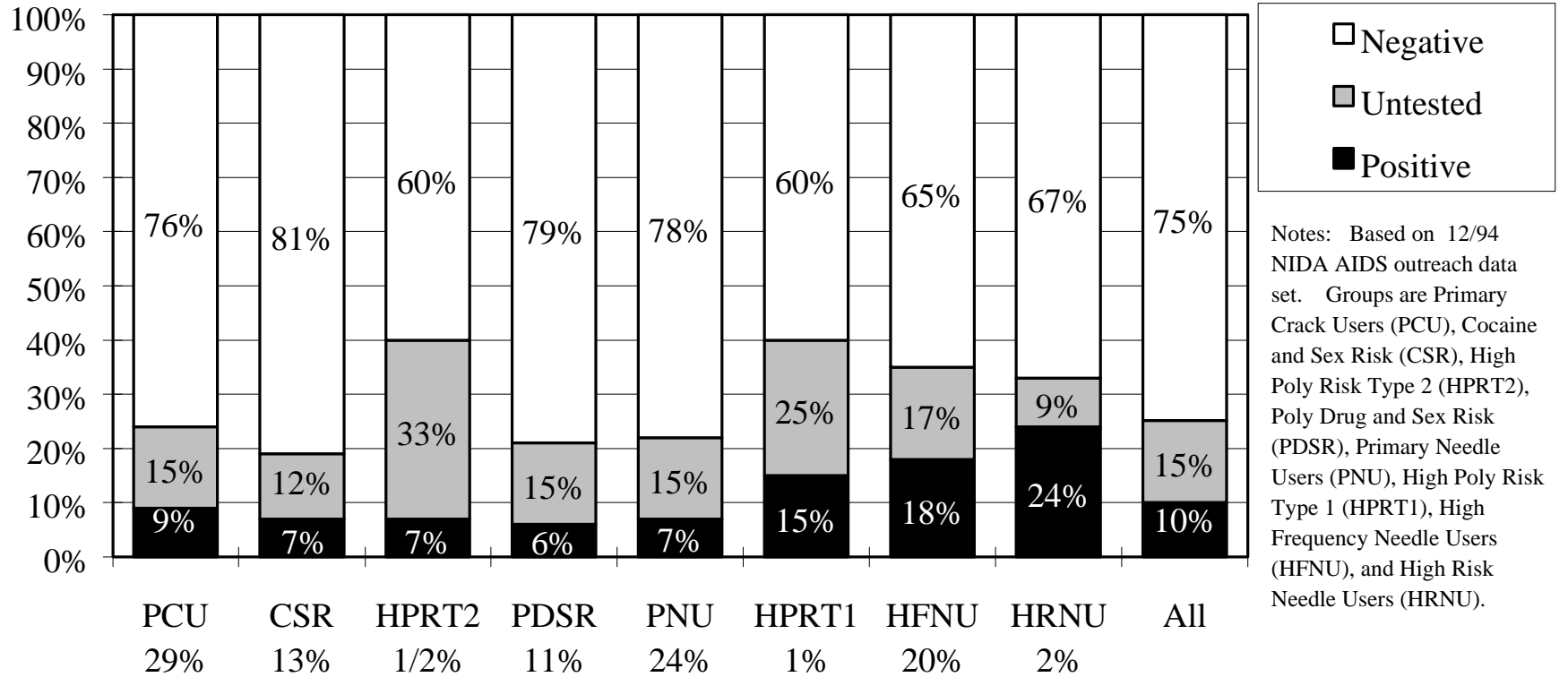


Figure 3. Substance Use Profile

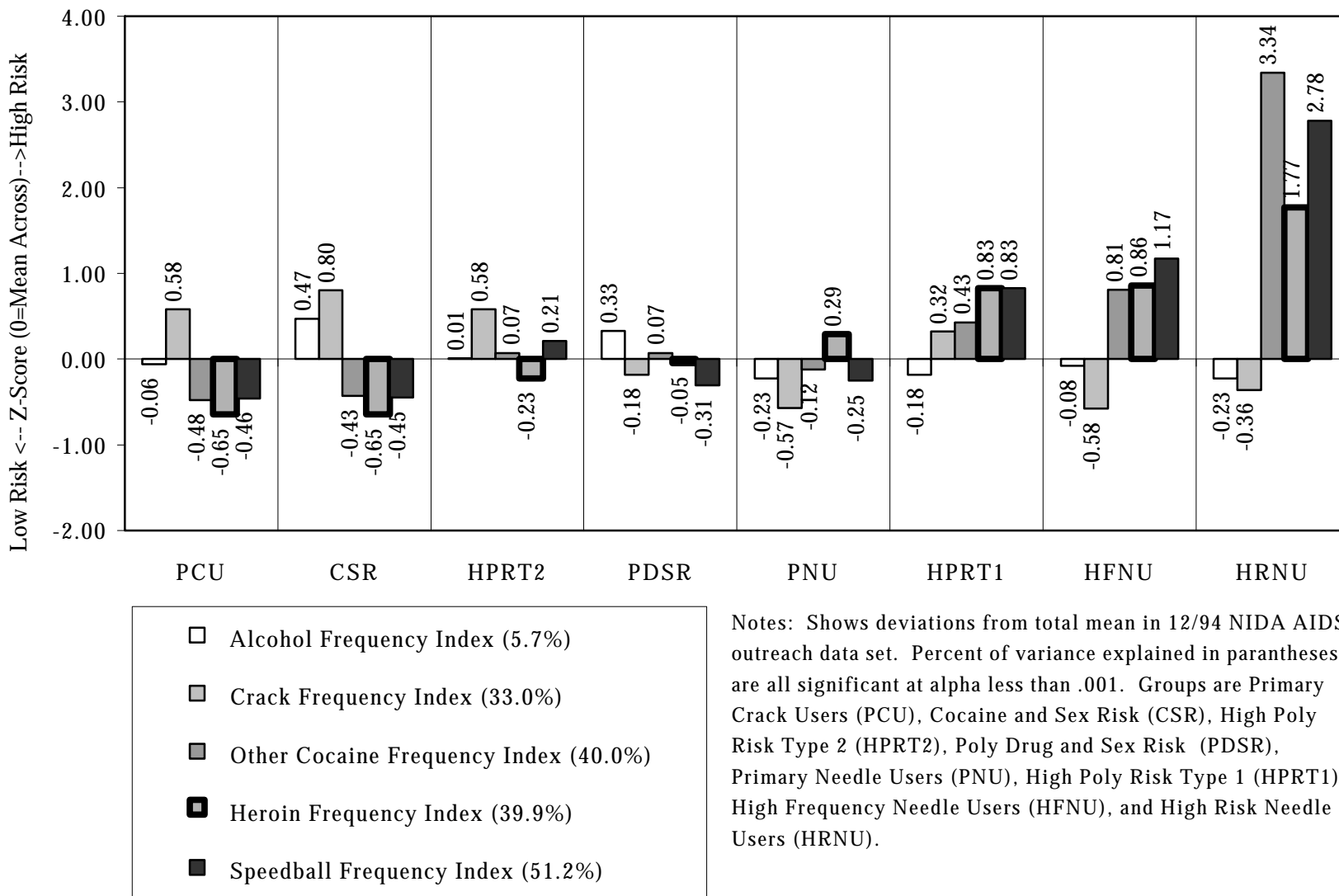
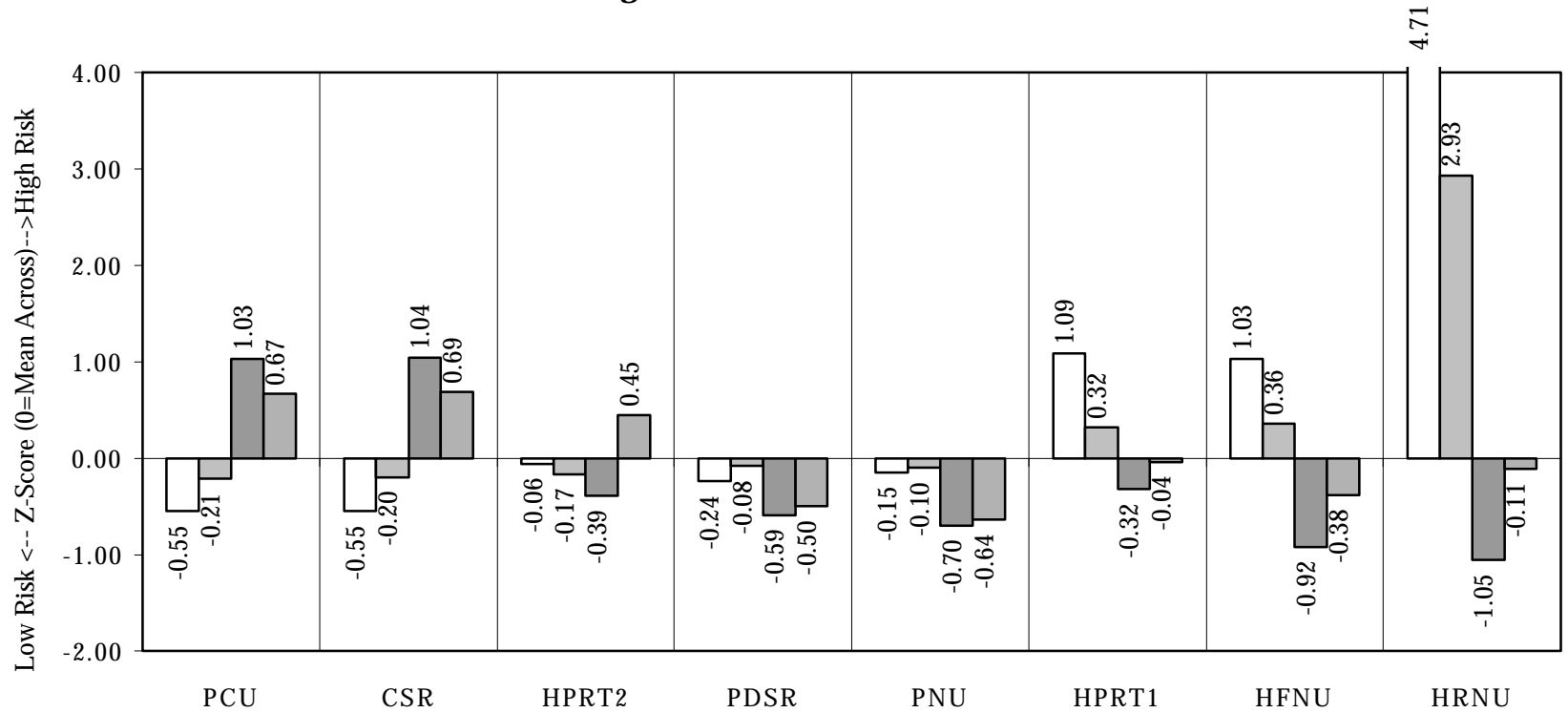


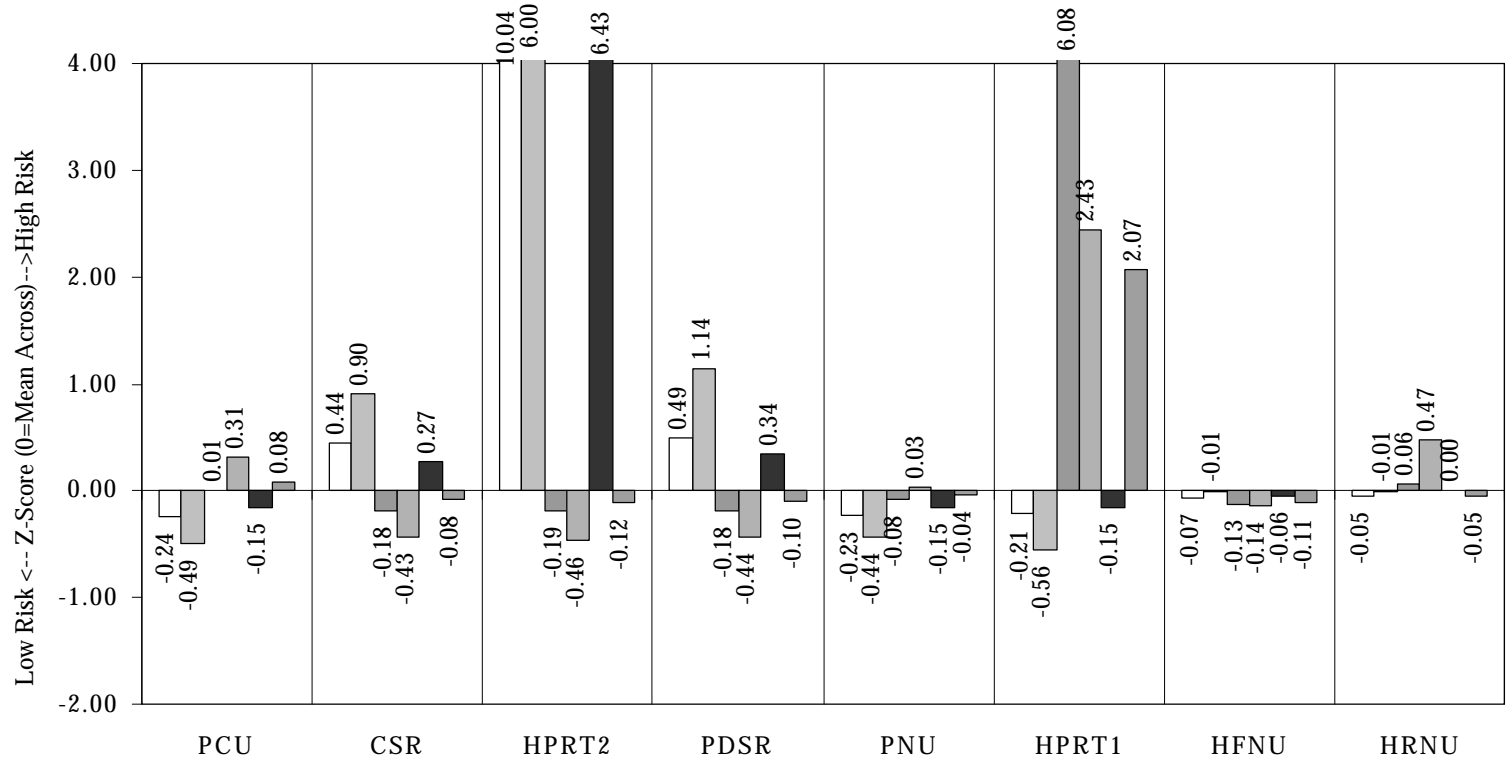
Figure 4. Needle Use Profile



- Needle Frequency Index (70.9%)
- Needle Sharing Index (18.2%)
- Needle Cleaning Index (79.3%)
- Needle Risk Reduction Index (34.6%)

Notes: Shows deviations from total mean in 12/94 NIDA AIDS outreach data set. Percent of variance explained in parantheses are all significant at alpha less than .001. Groups are Primary Crack Users (PCU), Cocaine and Sex Risk (CSR), High Poly Risk Type 2 (HPRT2), Poly Drug and Sex Risk (PDSR), Primary Needle Users (PNU), High Poly Risk Type 1 (HPRT1), High Frequency Needle Users (HFNU), and High Risk Needle Users (HRNU).

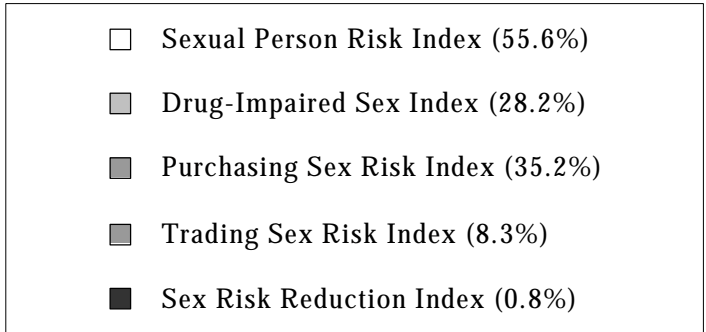
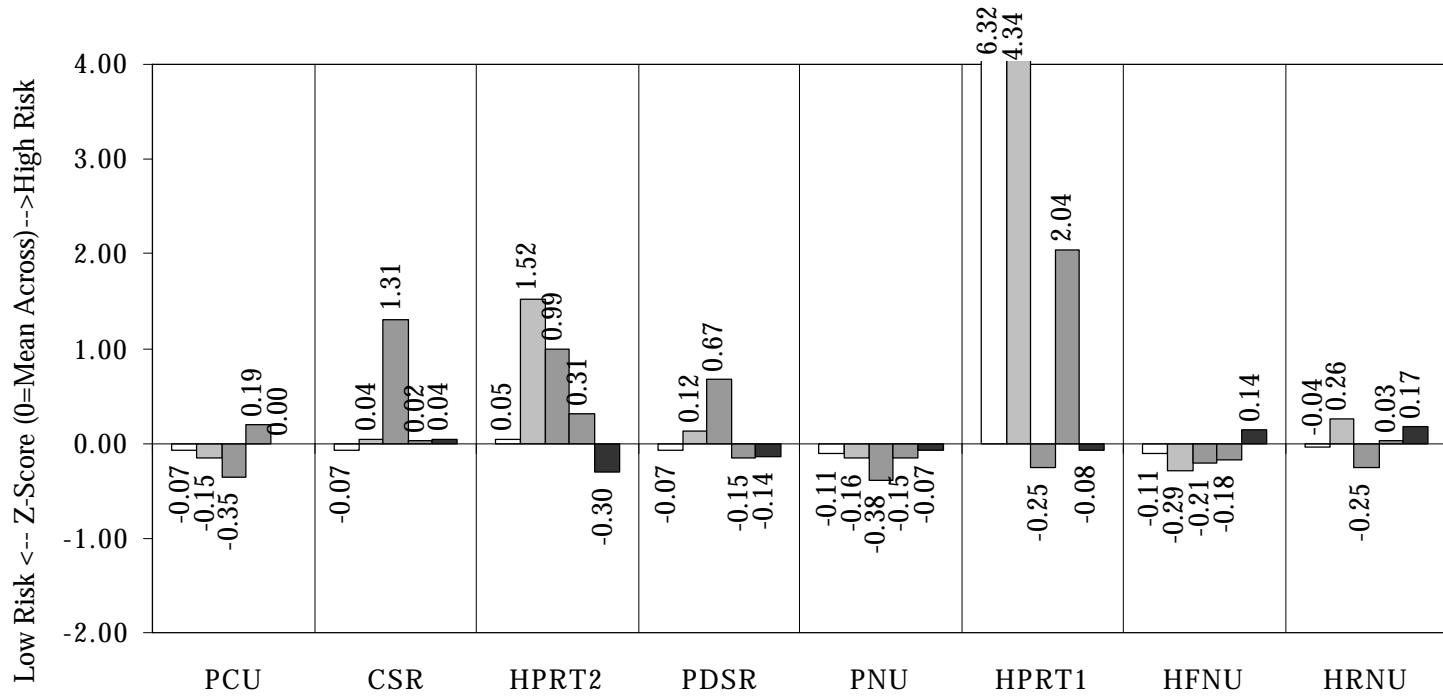
Figure 5. Sexual Activity Profile



- Male Sexual Pat. Freq. Index (42.2%)
- Male Sexual Pat. Prot. Index (48.9%)
- Female Sexual Pat. Freq. Index (52.0%)
- Female Sexual Pat. Prot. Index (15.9%)
- Anal Agency Risk Index (17.4%)
- Anal Receptive Risk Index (6.5%)

Notes: Shows deviations from total mean in 12/94 NIDA AIDS outreach data set. Percent of variance explained in parantheses are all significant at alpha less than .001. Groups are Primary Crack Users (PCU), Cocaine and Sex Risk (CSR), High Poly Risk Type 2 (HPRT2), Poly Drug and Sex Risk (PDSR), Primary Needle Users (PNU), High Poly Risk Type 1 (HPRT1), High Frequency Needle Users (HFNU), and High Risk Needle Users (HRNU).

Figure 6. Multi-Risk Behavior Profile



Notes: Shows deviations from total mean in 12/94 NIDA AIDS outreach data set. Percent of variance explained in parantheses are all significant at alpha less than .001. Groups are Primary Crack Users (PCU), Cocaine and Sex Risk (CSR), High Poly Risk Type 2 (HPRT2), Poly Drug and Sex Risk (PDSR), Primary Needle Users (PNU), High Poly Risk Type 1 (HPRT1), High Frequency Needle Users (HFNU), and High Risk Needle Users (HRNU).

Primary Crack/Cocaine Users Profile (29.2% PCU)

Demographically, this group was disproportionately female (52% female), predominately Black (71%), likely to be single (51%), and largely 25 years of age or older (89%). During the prior month, 30% had been homeless, 19% employed, and 7% arrested. Only 15% reported any lifetime needle use, with 9% reporting use in the past month. During the past 30 days, 96% reported using crack, 49% had a single sexual partner, 25% had multiple sexual partners, and 1% were men who had sex with men. As noted above, 9% were sero-positive for HIV and 15% were untested. In terms of the substance use profile (Figure 3), this group has an average rate of alcohol use, is tied for the second highest frequency of crack use, and is tied with CSR for the lowest rates of using cocaine, heroin, or speedballs. The high risk for failure to clean needles or change needle-related behaviors (Figure 4) is a methods artifact, as they do not “need” to do these things since they do not use needles. Rates of sexual activity (Figure 5) are close to average, with males at particularly low risk because of condom use and/or celibacy. Rates of multi-risk behaviors (Figure 6) for in this group suggest average to lower than average risk.

Cocaine and Sexual Risk Profile (12.8% CSR)

Demographically, this group was virtually all male (99%), predominately Black (79%), the most likely to be single (52%), and largely 25 years of age or older (94%). During the prior month, 42% had been homeless, 28% employed, and 7% arrested. About 18% reported any lifetime needle use, with only 8% reporting use in the past month. During the past 30 days 97% reported using crack, 39% had a single partner, 61% had multiple sexual partners, and 4% were men who had sex with men. As noted above, 7% were sero-positive for HIV and 12% were untested. In terms of the substance use profile (Figure 3), this group has the highest rates of alcohol and crack use, and is tied with PCU for the lowest rates of using cocaine, heroin, or speedballs. Like PCU, the high risk for failure to clean needles or change needle-related behaviors (Figure 4) is a methods artifact as they do not “need” to do these things since they do not use needles. Rates of male pattern sexual activity (Figure 5) are the third highest in terms of both frequency, failure to use condoms, and being the agent in anal sex. Rates of multi-risk behaviors (Figure 6) in this group are actually except for the fact that they are the group most likely to purchase sex with drugs or money.

High Poly Risk Type 2 Profile (0.3% HPRT2)

Demographically, this group was all male (100%), predominately Hispanic (47%) or Black (27%), the most likely to be separated, divorced or widowed (53%) and also included the largest percent of people under age 25 (20%). During the prior month, 47% had been homeless, 27% employed, and 0% reported being arrested. Over 47% reported lifetime needle use, with 49% reporting needle use in the past month. During the past 30 days 64% reported using crack, 13% had a single partner, 87% had multiple sexual partners, and 0% were men who had sex with men. As noted above, 7% were sero-positive for HIV and 33% were untested (the highest of any group). In terms of the substance use profile (Figure 3), this group had average alcohol use, was tied with PCU for the second highest rate of crack use, and had close to “average” rates of using cocaine, heroin, or speedballs. This group did appear to clean needles, but had not made many attempts to change their pattern of needle use (Figure 4). Rates of male pattern sexual activity (Figure 5) are the highest in terms of both frequency, failure to use condoms, and being the agent in anal sex. Rates of multi-risk behaviors (Figure 6) in this group are the second highest for drug impaired sex and purchasing sex with drugs or money.

Poly Drug and Sexual Risk Profile (10.9% PDSR)

Demographically, this group was almost entirely male (99%), proportionately Black (60%), proportionately single (45%) and largely older than age 25 (95%). During the prior month, 32% had been homeless, 26% employed, and 9% arrested. Over 99% reported lifetime needle use, with 97% reporting needle use in the past month. During the past 30 days, 49% reported using crack, 51% had a single partner, 49% had multiple sexual partners, and 3% were men who had sex with men. As noted above, 6% were sero-positive for HIV and 15% were untested. In terms of the substance use profile (Figure 3), this group had the second highest rate of alcohol use, average rates of using crack, heroin, and other forms of cocaine and below average rates of using speedballs. This group had below average needle use, did largely clean their needles and had attempted to change their needle use patterns (Figure 4). Rates of male pattern sexual activity (Figure 5) were the second highest in terms of both frequency, failure to use condoms, and being the agent in anal sex. Rates of multi-risk behaviors (Figure 6) in this group are the third highest for purchasing sex with drugs or money, but otherwise average.

Primary Needle Users Profile (24.1% PNU)

Demographically, this group was proportionately male (67%), slightly less likely to be Black (48%), single (42%), and largely 25 years of age or older (96%). During the prior month 29% had been homeless, 17% employed, and 8% arrested. Virtually all (99%) admitted to lifetime needle use and 97% reporting using needles in the past month. (This group did include some non-injecting opioid users.) During the past 30 days, 30% reported using crack, 47% had a single partner, 14% had multiple sexual partners, and 1% were men who had sex with men. As noted above, 7% were sero-positive for HIV and 15% were untested. In terms of the substance use profile (Figure 3), this group was tied for the lowest alcohol use, and reported the second lowest rate of crack use, average rates of other cocaine use, above average heroin use (including heroin smokers) and below average speedball use. This group had average rates of needle use and appeared to be reducing their risk by cleaning their needles or attempting to change their patterns of needle use (Figure 4). Rates of female pattern sexual activity (Figure 5) were below average risk; Rates of male pattern sexual activity and anal sex were average. Rates of multi-risk behaviors (Figure 6) were below average for purchasing sex, but otherwise average.

High Poly Risk Type 1 Profile (1.3% HPRT1)

Demographically, this group was overwhelming female (95%), less likely to be Black (36%), disproportionately Hispanic (33%), proportionately single (44%), and included a sizeable group of people under age 25 years (18%). During the prior month, 49% had been homeless (the highest), 8% employed (tied for the lowest), and 21% arrested (the highest). Most (89%) reported lifetime needle use and 72% reporting using needles in the past month. During the past 30 days, 57% reported using crack, 3% had a single partner, 97% had multiple sexual partners (the highest), and 5% were men who had sex with men (all of the men in this group). Defacto, this group was made up of people trading sex for drugs and to a lesser extent money. As noted above, 15% were sero-positive for HIV (third highest) and 25% were untested (second highest). In terms of the substance use profile (Figure 3), this group had average alcohol use, above average crack use, and the third highest rates of using cocaine, heroin and speedballs. This group had the second highest rate of needle use, third highest rate of sharing, was attempting to clean their needles and was average in their attempt to reduce their risk by attempting to change their patterns of needle use (Figure 4). Rates of female pattern sexual activity (Figure 5) were more than 6 standard deviations above any other group; moreover, the rates of having unprotected sex and being the receptive partner in anal sex were 2 standard deviations above any other group. Rates of multi-risk behaviors (Figure 6) were the highest by 2 to 4 standard deviations for having multiple partners/IDU partners, drug-impaired sex, and trading sex to get drugs or money.

High Frequency Needle Users Profile (19.8% HFNU)

Demographically, this group was proportionately male (77%), less likely to be Black (38%) or single (37%) and largely older than 25 years of age (97%). During the prior month, 30% had been homeless, 12% employed, and 7% arrested. All (100%) reported lifetime needle use with 99% reporting needle use in the past month. During the past 30 days 22% reported using crack, 47% had a single partner, 22% had multiple sexual partners, and 0.5% were men who had sex with men. As noted above, 18% were sero-positive for HIV (second highest) and 17% were untested. In terms of the substance use profile (Figure 3), this group had average alcohol use, the lowest crack use, and the second highest rates of using other forms of cocaine, heroin and speedballs. This group had the third highest rate of needle use, second highest rate of sharing, and was attempting to reduce their risk through cleaning needles and/or changing their patterns of needle use (Figure 4). Rates of sexual activity (Figure 5) were all average. The rates of drug-impaired sex (Figure 6) were slightly below average, but the other multi-risk behaviors were average.

High Risk Needle Users Profile (1.6% HRNU)

Demographically, this group was proportionately male (68%), the most likely to be Hispanic (65%), second most likely to be separated, divorced or widowed (49%) and included about 12% under age 25. During the prior month, 33% had been homeless, 9% employed, and 13% arrested (second highest). All (100%) reported lifetime needle use with 99% reporting needle use in the past month. During the past 30 days, 59% reported using crack, 33% had a single partner, 33% had multiple sexual partners, and 1% were men who had sex with men. As noted above, 24% were sero-positive for HIV (highest) and 9% were untested (lowest). In terms of the substance use profile (Figure 3), this group had below average alcohol and crack use, and the highest rates of using other forms of cocaine, heroin and speedballs. This group had the highest rate of needle use and sharing by over 2 standard deviations, but was attempting to clean needles and had made an average number of attempts to change their patterns of needle use (Figure 4). Rates of sexual activity (Figure 5) were average except for a higher than average rate of females failing to use condoms. The rates of multi-risk behaviors (Figure 6) were slightly above average in terms of drug-impaired sex and slightly below average for trading sex to get drugs or money.

Community Differences in Mix of Risk Profiles

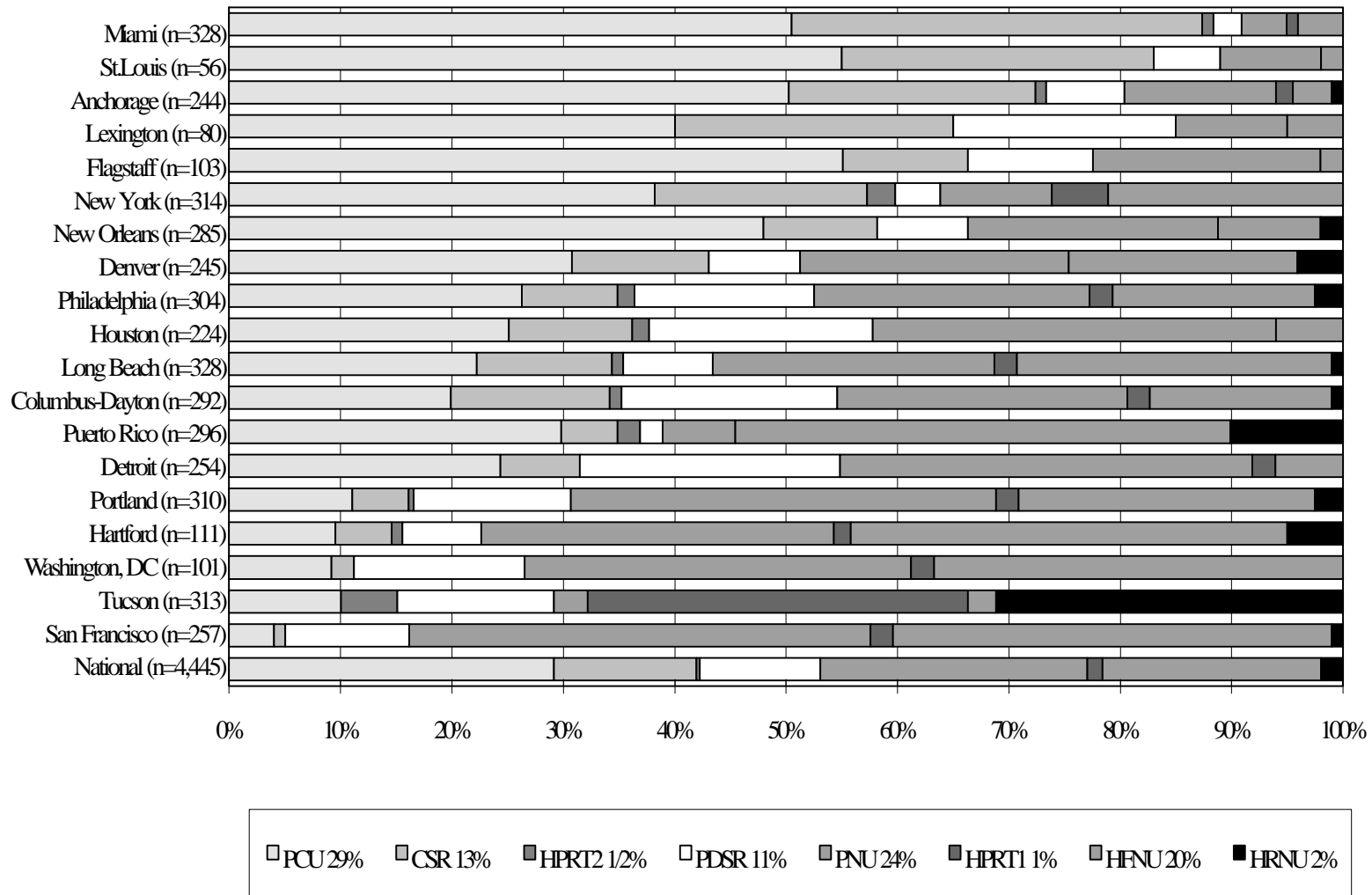
Methodologically, the preceding profiles suggest that there is considerable risk for specification error or potentially spurious correlations when using what might otherwise seem like relatively straightforward variables. For instance, 98% of the female drug abusers are in one of four groups (PCU, PNU, HFNU, HPRT1) and two groups are less than 1% female (CSR, HPRT2). Here we would like to focus on the issue of combining or comparing results across different communities. For multi-site analyses, many researchers would try to put in a dummy variable for site to control for community differences. The problem with this approach, as illustrated in Figure 7, is that the site or “community” is almost completely confounded with our HIV risk subgroups. Since our risk group variable is collinear with both site and virtually all of the potential measures of change in the RBA (discussed further below), including a “dummy” site variable prevents almost any other clinically relevant variable from being entered into many analyses. Conversely, failure to control for the substantial differences in risk groups between sites might render multi-site comparisons fairly meaningless (e.g., if a specific intervention only works for crack users, the success rate in a given site would largely be an artifact of the percent of subjects in that site who were crack users).

There are some important alternative approaches to this issue. Obviously, we can use the risk group variable to compare sites within a given risk groups (e.g., how well did each do with a similar type of client). But another thing we can do is use the case mix in Figure 7 to help classify sites that are similar to each other in terms of who they are serving. In this case, we would group them into three main population patterns:

1. Miami, St. Louis, Anchorage, Lexington, and Flagstaff - which are dominated by largely non-needle using crack groups (PCU, CSR) or the mixed groups (HPRT2, PDSR);
2. New York, New Orleans, Denver, Philadelphia, Houston, Long Beach, Columbus-Dayton, Puerto Rico, and Detroit - which each has a substantial mix of both non-needle and needle using groups; and
3. Portland, Hartford, D.C., Tucson and San Francisco - which are dominated by the needle using groups (PNU, HPRT1, HFNU, HRNU).

Comparisons within each of these three groups are going to be less confounded with case mix differences than those across the three groups. Moreover, we have been able to apply the group variable to the newer sites that were not included in the original sample (Dennis et al., 1998) and draw some conclusions that Rio de Janeiro, Brazil and Durham/Wake, NC clearly fall in the first group while San Antonio, TX falls in the third.

Figure 7. Comparisons of HIV Risk Subgroups by Site and Overall



Validation of Risk Profiles

The fundamental purpose of developing a risk group typology would be to help with program planning and evaluation. By clustering on the major dependent variables that can be used to measure change, we are basically creating a multi-variate pre-test. Unlike simple pretests that only address the main effects of a single baseline behavior, our risk group typology also takes into account the interactions. But how well does this work? Below are brief summaries of several analyses we have done to evaluate this cluster solution of HIV risk groups.

Reverse Validation. Figure 1 on the four factor dimensions and Figures 3 to 6 on the 20 conceptual measures show the differences between each group: next to the label for each scale is the percentage of variance explained in that scale by the “Risk Groups.” The graphed values are z-scores and show the difference from the grand mean of the total sample (0) to the centroid of each subgroup divided by the number of standard deviations for that score. This is a form of an “effect size.” Thus, a score of about .2 is a small difference, .4 a moderate difference, .8 or larger a major difference. The observed differences range from -2.23 to +16.78 and reveal a very heterogeneous population. At baseline, these HIV Risk Groups of drug users were able to explain 55.9 to 82.3% of the variance in the four statistical dimensions and 99.6% of their joint distribution. For the 20 conceptual indices it explained from 0.0 to 79.3% and 99.9% of their joint distribution: this includes 50% or more for the variance of 5 measures, 30-49% for the variance of 7, 10-29% of the variance of 4, and 0-10% for 4 (Alcohol frequency, anal receptive anal risk, trading sex risk, and sex risk reduction). The high percentage of variance explained in the joint distribution can be interpreted as a good model fit (i.e., reverse validation) and minimizes the need for additional covariates unless one is just looking at a handful of the measures (Rapkin & Luke, 1993).

Predictive Validity. In terms of evaluation, one of the most important tests of our risk group typology is the extent to which it can be used as a blocking or stratifying variable when predicting the future. Though the NIDA cooperative agreement studies were still collecting data in the field at the time this data was created (and still are at this writing), we had access to follow-up RBFAs for 1799 drug users (~40%). The risk group variable was significantly related to the probability of completing a follow-up interview ($\chi^2_{(7)} = 91.75, p < .0001$). Moreover, three of the four lowest rates of follow-up were in the groups with above average rates of HIV (HPRT1, HFNU, HRNU), and the fourth had the highest rate of being untested (HPRT2). Using the baseline risk group we were able to explain from 12.8 to 36.4% of the variance in the four statistical dimensions and 62.8% of their joint distribution at follow-up; and 0.3 to 37.2% of the variance of the 20 conceptual Indices and 77.1% of their joint distribution. This means that our risk group measure can be used as a multidimensional covariate or blocking variable and dramatically increase power or reduce the required sample size. For a given level of power (80%) and Type 1 error (.05), using the risk group measure would reduce the sample size required to detect a given effect size of:

- .01 from 1,569 to 199 people
- .35 from 274 to 35 people
- .50 from 68 to 10 people (Dennis, Lennox & Foss, 1997).

More important, however, is the fact that these risk groups help bring the impact of interventions into focus. To illustrate this we calculated the effect size of the pre- to-post change in each of the 21 simple questions overall, and then within each of the eight risk groups. Then, we classified the effects by direction (increased or decreased risk) and by effect sizes (no effect if 0 to .19, small if .2 to .39, medium if .40 to .79, and large if .80 or more; see Dennis, Lennox, & Foss, 1997 for a discussion of effect sizes). Out of the 20 measures evaluated across groups, 12 showed no effect, 8 showed a small reduction and 1 showed a small increase. However, this was completely a methodological artifact of the mix of the risk group composition. We say this because, on average within individual risk groups the comparisons only showed 5 no effects, 8 small negative effects, 4 medium decreases, 2 large decreases and 2 small increases. The difference between these results occurred because many of the large effects were limited to the relevant group (e.g., reduced needle sharing among needle sharers, reduced trading sex among the small groups of women who were actively trading sex). Averaging these effects over other people washed them out. Inspection of Figure 8 in the Appendix also shows that the number of “no effects” ranged from a high of 18 of the 21 questions evaluated to a low of 3.

Comparison with alternative adjustments. To evaluate how good the risk groups work at explaining risk behaviors, Table 2 in the Appendix compares how well our expected risk group does at predicting the variance of the four main dimensions at baseline and follow-up relative to a) site dummy variables, b) gender, c) NIDA’s prior target population variable (Injector, crack user or both), and d) current sexual activity. At baseline it did better than all of the other models. At follow-up it did better on every measure than all the models except for “target population”, which did slightly better at predicting the crack user dimensions (47.6% vs. 36.4%).

Cross Validation and Replication. We also wanted to be able to prospectively classify future individual respondents on a case-by-case basis for cross-site analyses and even for prospective blocking (i.e., stratification) prior to randomization. All of the alphas and percents of variance predicted were within a tenth of a percentage point when we ran them on the second random quarter of the national data. This is not really surprising since, with such large sample sizes, this comparison turns into a test of “random sampling” and the “law of large numbers” to average things out. We, therefore, replicated the analysis again on a third sample from our North Carolina site that had not been in the original data. This time it actually did better in terms of the observed alpha and percentage of variance it was able to predict in the future -- though the latter may be so because North Carolina follow-ups were being completed an average of one month earlier than in the older national data set. We also look at the ability of the discriminant rule based on only 21 items to predict the group. Despite the fact that it was based on 1/10th the variables, the percent of variance predicted at intake and follow-up was never more than a percentage point off.

Checking for Potential Regression to the Mean. When dividing people up based on pretest scores it is always

important to check for potential regression to the mean (Campbell & Stanley, 1963; Cook & Campbell, 1979). When this happens high scoring groups tend to come down and low scoring groups tend to go up. This did not happen here. In fact, a reverse fan effect was found in which the most severe groups changed the most, those in the middle changed the next, and the least severe changed the least. This suggests both the presence of a main effect and a subject-by-treatment interaction. In fact, a quick review of Figure 8 in the appendix shows that the ratio of positive to negative effect sizes ranged from 2:1 up to 13:0.

Implications and Next Steps

Like most multi-variate methods, cluster analysis is highly dependent on what is included in the model and is often open to multiple interpretations. Our approach here was to focus on the measures of change that could be used in arguably the largest multi-site study of AIDS outreach to drug users in the U.S., Puerto Rico and Brazil. Our assumption here was that if things like gender or homelessness were going to be correlated with a risk behavior at follow-up, they would probably also be correlated with that behavior at baseline. By clustering on the dependent variables at baseline, we believe that we have constructed a multi-variate pretest that combines main effects and several interactions. While this may be somewhat more difficult to interpret, we believe that it is actually a more accurate representation of the answers given by out-of-treatment drug users (who had nothing near factorially-distributed risk behaviors).

From a program planning point of view, we have tried to demonstrate that while a focus on needle use is important - it is not sufficient. While 60% of the drug users in this study had used needles, most did so infrequently, and were trying to clean or change their pattern of use: 76% did not share needles. Interventions should acknowledge the steps they have been taking but need to check on their effectiveness. If they recognize and use information on early attempts to change, outreach workers may also be able to help motivate drug users to enter more formal substance abuse treatment.

The big news for program planning, however, is the complicated mosaic of relationships between drugs and sex. The three male groups purchasing sex for drugs or money (CSR, HPRT2, and PDSR) and the one female group selling sex for drugs or money (HPRT1) are coming in contact with many people, and may need very different interventions than the other groups that were dominated by people who had been with 0-1 sexual partners in the past month. Moreover, it is not clear that these four high risk groups even need the same things. For instance, the HPRT2 and HPRT1 also had significantly higher elevations of using drugs during sex, while the other two seemed not to be doing so.

Further investigation is needed for the primary crack users. Neither their needle use nor sexual practices offers a simple explanation why their rates of HIV are so high and comparable with primary needle users. Anecdotal evidence suggests that it may related to increased genital abrasions that result from prolonged intercourse and/or their ignoring pain or the lack of lubrication. However, this is just speculation and needs to be confirmed qualitatively.

Methodologically this paper also helped to demonstrate the heterogeneity of community based samples and the importance of subgroup analysis for increasing design sensitivity and interpretation. We have already used this risk group variable as a blocking variable prior to randomization in our Durham/Wake site and to facilitate other cross-site analyses (e.g, Wechsberg, Dennis, & Stevens, in press). We also continue to explore other potentially simpler ways of controlling for these real differences among out-of-treatment drug users.

Authors' Notes

This research was supported by Cooperative Agreement No. U01 DA08007 from the National Institute on Drug Abuse (NIDA). The opinions expressed are solely those of the authors and do not reflect official positions of NIDA. This poster is based largely on a manuscript that is currently under review and included two additional authors, Supatra Campbell of RTI and Melessia McDermeit of Chestnut. This research was undertaken in response to several methodological problems raised by the NIDA and cooperative agreement staff over the past several years and builds heavily on their earlier works. In addition to their advice, this entire study would not have been possible without the use of data pooled across all of the contributing sites. We are deeply indebted to the PIs of the individual sites for sharing their data, staff from NIDA, NOVA and several sites working on methodological issues, and the feedback of several individuals. Too list only some, they include: Marcia Anderson, Robert Booth, Supatra Campbell, Linda Cottler, Susan Coyle, Sherry Deren, David Desmond, Dennis Fisher, Jeffrey Hoffman, James Inciardi, Lynne Kotranski, Carl Leukefeld, Clyde McCoy, Melessia McDermeit, Isaac Montoya, Richard Needle, Fen Rhodes, Rafaela Robles, Vernon Shorty, Harvey Siegal, Merrill Singer, Michael Stark, Sally Stevens, Robert Trotter, John Watters, Norman Weatherby, and Mark Williams. We would also like to thank Theresa Gurley, Bruce MacDonald, Rebecca Perritt, Nat Rodman and Joan Unsicker for their assistance in preparing this manuscript. An adobe copy of this poster can be downloaded from www.chestnut.org/files2, filename: WAC98TXT.PDF) Please address comments, questions or requests for reprints to Michael Dennis, Chestnut Health Systems, 720 West Chestnut, Bloomington, IL; phone (309) 827-6026; or Internet MDennis@Chestnut.Org.

References

- Aldenderfer, M. S., and Blashfield, R. K. (1984). Cluster analysis. Newbury Park, CA: Sage Publications.
- Anderberg, M. (1973). Cluster Analysis for Applications. New York, NY: Academic Press.
- Anderson, R.N., Kochanek, K.D., & Murphy, S.L. (1997). Report of final mortality statistics, 1995. Monthly Vital Statistics Report, 145(11), (Supp. 2, Table 7). Hyattsville, MD: National Center for Health Statistics.
<<http://www.cdc.gov/nchswww/SSBR/45112t07.htm#foot>>
- Anderson, M., Hockman, E., & Smereck, G.A.D. (1996). Effect of a nursing outreach intervention to drug users in Detroit, Michigan. Journal of Drug Issues, 26(3), 619-634.
- Anglin, M.D., Hser, Y., & Chou, C. (1993). Reliability and validity of retrospective behavioral self-report by narcotics addicts. Evaluation Review, 17(1), 91-108.
- Association of State and Territorial Health Officers (1988). Intravenous drug use and HIV transmission: recommendations by the ASTHO Committee on HIV. Washington, DC: Author.
- Ben-Abdallah A, Cottler LB, Compton WM, Dinwiddie SH, Woodson SM. (1996, August). Subtyping Risks of HIV Infection: A Latent Class Analysis of Drug and Sex Behaviors. Presentation at the American Psychological Association conference, Toronto, Canada.
- Blattner, W.A., Biggar, R.J., Wiess, S.H., Melbye, M., & Goedert, J.J. (1985). Epidemiology of human T-lymphotropic virus type III and the risk of acquired immunodeficiency syndrome. Annals of Internal Medicine, 103, 665-670.
- Booth, R., Crowley, T.J., & Zhang, Y. (1996). Substance abuse treatment entry, retention, and effectiveness: Out-of-treatment opiate injection drug users. Drug and Alcohol Dependence, 42, 11-20.
- Brown, B., Beschner, G., and the National AIDS Consortium. (1993). At risk for AIDS: Injection drug users and sexual partners. Westport, CT: Greenwood Press.
- Campbell, D.T., & Stanley, J.S. (1963). Experimental and quasi-experimental designs for research on teaching. In N.L. Gage (Ed.), Handbook of research on teaching. Boston: Houghton Mifflin Co.
- Carlson, R.G., Wang, J., Siegal, H.A., Falck, R.S., & Guo, J. (1994). An ethnographic approach to targeted sampling: Problems and solutions in AIDS prevention research among injection drug and crack cocaine users. Human Organization, 53, 279-286.
- Centers for Disease Control. (1987). HIV virus in the U.S.: A review of current knowledge. MMWR, 36(Supp 6), 52-53.
- Centers for Disease Control. (1995, February). HIV/AIDS Prevention. Atlanta, GA: Author.
- Centers for Disease Control. (1996). HIV/AIDS Surveillance Report, 8(1). Atlanta, GA: Author.

Centers for Disease Control and Prevention. (1997). HIV/AIDS Surveillance Report, 9(2). Atlanta, GA: Author.

Colon, H., Sahai, H., Robles, R.R., & Matos, T.D. (1995). Effects of a community outreach program in HIV risk behaviors among injection drug users in San Juan, Puerto Rico: An analysis of trends. AIDSS Education and Prevention, 7(3), 195-209.

Cook, T.D., and Campbell, D. (1979). Quasi-experimentation: Design and analysis issues for field settings. Boston, MA: Houghton-Mifflin.

Coyle, S. (1993). The NIDA standard intervention model for injection drug users not in treatment: Intervention manual. Rockville, MD: National Institute on Drug Abuse.

Coyle, S.L., Boruch, R.F., & Turner, C.F. (Eds.). (1989). Evaluating AIDS prevention programs. Washington, DC: National Academy Press.

Dennis, M.L., Lennox, R.D., & Foss, M.A. (1997). Practical power analysis for planning substance abuse prevention and services research. In K.J. Bryant, M. Windle, & S.G. West (Eds.), Recent advances in prevention research methodology: Lessons from alcohol and substance abuse research (pp. 367-404). Washington, DC: American Psychological Association.

Dennis, M.L., & Wechsberg, W.M. (1996, August). Methodological lessons from the NIDA AIDS outreach program. Paper presented at the American Psychological Association Meeting, Toronto, Ontario, Canada.

Deren, S., Davis, W.R., Beardsley, M., Tortu, S., & Clatts, M. (1995). Outcomes of a risk reduction intervention with high risk populations: The Harlem AIDS Project. AIDS Education and Prevention, 7(5), 379-390.

Des Jarlais, D.C., & Friedman, S.R. (1987). HIV infection among intravenous drug users: Epidemiology and risk reduction. AIDS, 1 (1), 67-76.

Dowling-Guyer, S., Johnson, M.E., Fisher, D.G., Needle, R., Watters, J., Anderson, M., Williams, M., Kotranski, L., Booth, R., Rhodes, F., Wearthby, N., Estrada, A.L., Fleming, D., Deren, S., & Tortu, S. (1994). Reliability of drug users' self-reported HIV risk behaviors and validity of self-reported recent drug use. Assessment, 1, 383-392.

Drake, R.E., McHugo, G.J., & Biesanz, J.C. (1995, March). The Test-retest reliability of standardized instruments among homeless persons with substance use disorders. Journal of studies on alcohol, 161-167.

Dwyer, R., Richardson, D., Ross, M.W., Wodak, A., Miller, M.E., & Gold, J. (1994). A comparison of HIV risk between women and men who inject drugs. AIDS Education and Prevention, 6 (5), 379-389.

Friedland, G.H., Harris, C., Butkus-Small, C., Shine, D., Moll, B., Darrow, W., & Klein, R. (1985). Intravenous drug users and the Acquired Immunodeficiency Syndrome: Demographics, drug users and needle sharing patterns. Archives of Internal Medicine, 145, 1413-1417.

Gerstein, D.R., Ingles, J., Datta, R., Talley, K., Jordan, K., Schildhaus, S., Johnson, R., Rasinski, K., Taylor, J., Bacellar, H., Anderson, D., Phillips, D., Collins, J., Condelli, W., Ciftan, E., & Rohde, F. (1997). National Treatment Improvement Evaluation Study (NTIES)

Main Findings. Rockville, MD: SAMHSA Center for Substance Abuse Treatment.

Haverkos, H.W., & Lange, W.R. (1990). Serious infections other than immunodeficiency virus among intravenous drug abusers. Journal of Infectious Diseases, *161*, 894-902.

Higgins, D.L., Galavotti, C., O'Reilly, K.R., Schuell, D.J., Moore, M., Rug, D.L., & Johnson, R. (1991). Evidence for the effects of HIV antibody counseling and testing on risk behaviors. Journal of the American Medical Association, *266*(17), 2419-2429.

Illinois Department of Public Health, AIDS Activity Section (1997). Special runs provided from state data. Author.

Inciardi, J. (1994). HIV/AIDS risks among male, heterosexual non-injecting drug users. In NIDA Research Monograph Series: The Context of HIV Risks Among Drug Users and Their Sexual Partners. Rockville, MD: National Institute on Drug Abuse.

Joe, G.W., & Simpson, D.D. (1995). HIV risks, gender, and cocaine use among opiate users. Drug and Alcohol Dependence, *37*, 23-28.

Jose, B., Friedman, S.R., Neaigus, A., Curtis, R., Grund, J.P.C., Goldstein, M.F., Ward, T.P., & Des Jarlais, D.C. (1993). Syringe-mediated drug-sharing (backloading): A new risk factor for HIV among injection drug users. AIDS, *7*, 1653-1660.

Keller, M.B., Lavori, P.W., McDonald-Scott, P., Endicott, J., Andreasen, N., & Van Eerdewegh, M.M. (1983). The reliability of retrospective treatment reports. Psychiatry Research, *9*, 81-88.

Koester, S.K. (1994). Copping, running, and paraphernalia laws: Contextual variables and needle risk behavior among injection drug users in Denver. Human Organization, *53*(3), 287-295.

Koester, S.K., Booth, R., & Wiebel, W. (1990). The risk of HIV transmission from sharing water, drug mixing containers and cotton filters among intravenous drug users. International Journal of Drug Policy, *1*(6), 28-30.

Kraemer, H.C. (1992). Evaluating medical tests: Objective and quantitative guidelines. Newbury Park, CA: Sage.

Leukefeld, C.G., Battjes, R.J., & Amsel, R.J. (1990). AIDS and intravenous drug use: Community intervention and prevention. New York: Hemisphere Publishing.

Longshore, D. & Anglin, M.D. (1995). Number of sex partners and crack cocaine use: Is crack an independent marker for HIV risk behavior? Journal of Drug Issues, *22*(1), 1-16.

McCoy, C.B., & Inciardi, J.A. (1995). Sex, drugs, and the continuing spread of AIDS. Los Angeles, CA: Roxbury Publishing.

McCoy, C.B., Weatherby, N.L., Metsch, L.R., McCoy, H.V., Rivers, J.E., & Correa, R. (1996). Effectiveness of HIV interventions among crack users. Drugs and Society, *7*, 137-154.

Needle, R.H., & Coyle, S.L. (1997). Community based outreach risk reduction strategy to prevent HIV risk behaviors in out-of-treatment injection drug users, (NIH Consensus Development Conference on Interventions to Prevent HIV Risk Behaviors). Rockville, MD: National Institute on Drug Abuse, Division of Epidemiology and Prevention

Research, Community Research Branch. [Available from first author at RN28E@nih.gov.]

Office of Applied Studies (1997). Preliminary results from the 1996 National Household Survey on Drug Abuse. Rockville, MD: Substance Abuse and Mental Health Services Administration, Office of Applied Studies.

Oliver, K. J., Friedman, S.R., Maynard, H., Magnuson, L., & Des Jarlais, D.C. (1992). "Impact of a needle exchange program on potentially infectious syringes in public places." Journal of Acquired Immune Deficiency Syndromes, 5(5), 534-535.

Rapkin, B.D., & Luke, D.A. (1993). Cluster analysis in community research: Epistemology and practice. American Journal of Community Psychology, 21, 247-277.

Rhodes, F. & Malotte, C.K. (1996). HIV risk interventions for active drug users: Experience and prospects. In S. Oskamp, & S. C. Thompson (Eds.), Understanding and preventing HIV risk behaviors. Thousand Oaks, CA: Sage. Pp., 207-236.

Rouse, B.A., Kozel, N.J., & Richards, L.G. (Eds.). (1985). Self-report methods of estimating drug use: Meeting current challenges to validity. (NIDA Research Monograph 57, DHHS Publication No. ADM 85-1402). Rockville, MD: National Institute on Drug Abuse.

Stall, R. & Leigh, B. (1994). Understanding the relationship between drug or alcohol use and high risk sexual activity for HIV transmission: Where do we go from here? Addiction, 89, 131-134.

Stephens, R.C., Simpson, D.D., Coyle, S.L., McCoy, C.B. and the NADR Consortium. (1993). Comparative effectiveness of NADR interventions. In B.S. Brown & G.M. Beschner (eds.), Handbook on Risk of AIDS. Westport, CT: Greenwood Press. Pp. 519-556.

Stevens, S.J., Tortu, S. & Coyle, S.L. (Eds) (1998). Women, drug use and HIV infection. New York, NY: Haworth Medical Press.

Stryker, J., & Smith, M.D. (Ed.s) (1993). Dimensions of HIV prevention: Needle exchange. Menlo Park, CA: Kaiser Forums.

Trotter, R.T., Bowen, A.M., Baldwin, J.A., & Price, L.J. (1996). The efficacy of network based HIV/AIDS risk reduction programs in mid sized towns in the United States. Journal of Drug Issues, 26(3), 591-605.

Turner, C.F., Miller, H.G., & Moses, L.E. (Eds.), (1989). AIDS: Sexual behavior and intravenous drug use. Washington, DC: National Academy Press.

U.S. Department of Health and Human Services. (1994). Outreach/risk reduction strategies for changing HIV-related risk behaviors among injection drug users. (NIH Publication No. 94-3726). Rockville, MD: Author.

Ward, J. (1963). Hierarchical grouping to optimize an objective function. Journal of the American Statistical Association, 58, 236-244.

Watkins, J.D., Conway-Welch, C., Creedon, J.J., Crenshaw, T.L., DeVos, R.M., Gebbie, K.M., Lee, B.J., III, Lilly, F., O'Connor, J.C., Primm, B.J., Pullen, P., SerVaas, C., & Walsh, W.B. (1988). Report of the Presidential Commission on the human immunodeficiency virus epidemic (Submitted to the President of the United States). Washington, DC: U.S. Government Printing Office.

Watters, J.K., & Biernacki, P. (1989). Targeted sampling: Options for the study of

hidden populations. Social Problems, 36, 416-430.

Weatherby, N.L., Needle, R., Cesari, H., Booth, R., McCoy, C., Watters, J., Williams, M., & Chitwood, D. (1994a). Validity of self-reported drug use among injection drug users and crack cocaine users recruited through street outreach. In M.L. Dennis & W.M. Wechsberg (Eds.), Special issue: Evaluating drug abuse interventions. Evaluation and Program Planning, 17, 347-355.

Weatherby, N.L., Needle, R., Cesari, H., Booth, R., McCoy, C., Watters, J., Williams, M., & Chitwood, D. (1994b). Reply to Wish and Mieczkowski. In M.L. Dennis & W.M. Wechsberg (Eds.), Evaluating drug abuse interventions. Evaluation and Program Planning, 17, 331-342.

Wechsberg, W.M., and Cavanaugh, E.R. (in press). Differences found between women in and out of treatment. In S. Stevens and H. Wexler (Eds.), Drugs and Society (Special Edition).

Wechsberg, W.M., Dennis, M.L., & Stevens, S.J. (1998). Cluster analysis of HIV intervention outcomes among substance abusing women. The American Journal of Drug and Alcohol Abuse, in press.

Wechsberg, W.M., Dennis, M.L., & Ying, Z. (1995, November). Women and men injectors: Differences and trends in their drug use patterns and HIV risk. Presentation at the meeting of the American Public Health Association, San Diego, CA.

Wechsberg, W.M., Stevens, S.J., Rasch, R.F.R., Dennis, M.L., Rodman, N., & Estrada, A. (1997). Regional and gender differences in drug and sexual patterns, HIV risk, and behavioral changes with ethnic diversity. Presentation at the College on Problems on Drug Dependency (CPDD), Nashville, TN.

Weeks, M.R., Himmelgreen, D.A., Singer, M., Wolley, S., Romero-Daza, N., & Grier, M. (1996). Community based AIDS prevention: Preliminary outcomes of a program for African American and Latino Injection Drug Users. Journal of Drug Issues, 26, 561-590.

Wiebel, W. W., Jimenez, A., Johnson, W. Ouellet, L., & Jovanovic, B. (1996). Risk behavior and HIV seroincidence among out-of-treatment injection drug users: A four year prospective study. Journal of Acquired Immune Deficiency, 12, 282-289.

Williams, M.L., Zhao, Z., Freeman, R.C., Elwood, W.N., Rusek, R. Booth, R.E., Dennis, M.L., Fisher, D.G., & Rhodes, F. (in press). A cluster analysis of not-in-treatment drug users at risk for HIV infection. The American Journal of Drug and Alcohol Abuse.

U.S. Department of Health and Human Services. (1994). Outreach/risk reduction strategies for changing HIV-related risk behaviors among injection drug users. (NIH Publication No. 94-3726). Rockville, MD: Author.

Appendix With Additional Materials

Table 1. List of Core Domains and Conceptual Measures

Substance Use Frequency

- AFI** **Alcohol Frequency Index** (alpha = .74): based on the z-score of days of use, times used, and use in the past 48 hours (weighted).
- CFI** **Crack Frequency Index** (alpha = .79): based on the z-score of days of use, times used, and use in the past 48 hours (weighted).
- OCFI** **Other Cocaine Frequency Index** (alpha = .88): based on the z-score of days of use, days of injecting, times injecting, and use in the past 48 hours (weighted).
- HFI** **Heroin Frequency Index** (alpha = .93): based on the z-score of days of use, days of injecting, times injecting, and use in the past 48 hours (weighted).
- SFI** **Speedball Frequency Index** (alpha = .93): based on the z-score of days of use, days of injecting, times injecting, and use in the past 48 hours (weighted).

Needle Practices

- NFI** **Needle Frequency Index** (alpha = .76): sum of z-scores on times injecting cocaine, heroin, speedballs, and any drug (weighted).
- NSRI** **Needle Sharing Risk Index** (alpha = .79): sum of the frequency of using works that had been used first by anyone else, by a husband/wife/lover, by a running buddy, by a friend; and the frequency of giving own works to anyone else, a husband/wife/lover, a running buddy, or a friend.
- NCI** **Needle Cleaning Index** (alpha = .76): reversed sum of the dichotomized measures of whether the individual had cleaned works with bleach and water, used “new” works, used own new works again.
- NRRI (rev.)** **Needle Risk Reduction Index** (alpha = .69): reversed sum of dichotomized measures of attempting to cut back on IV drug use, needle sharing, and/or cleaned needles with bleach more often during the past 30 days.

General Sexual Activity

- MSPFI** **Male Sexual Pattern Frequency Index** (alpha = .76): factor-weighted sum of z-scores of the frequency of being agent (primary provider of fluid) during fellatio and vaginal sex, frequency of being receptor (primary receiver of fluid) during cunnilingus, frequency of using protection when agent in fellatio and vaginal sex and receptor of cunnilingus.
-

-
- MSPPI Male Sexual Pattern Protection Index** (alpha = .80): factor weighted (and (rev.) reversed) sum of z-scores of the percent of time using protection when receptor of cunnilingus, agent in vaginal sex plus (negatively weighted) frequency of being receptor of cunnilingus, receptor of fellatio, and receptor of vaginal sex.
- FSPFI Female Sexual Pattern Frequency Index** (alpha = .84): factor-weighted sum of z-scores of the frequency of fellatio reception (primary receiver of fluid), vaginal reception, and cunnilingus agent (primary provider of fluid); and the frequency of using protection when receptor (receiver of fluid) during fellatio and vaginal sex.
- FSPPI Female Sexual Pattern Protection Index** (alpha = .75): factor-weighted (and (rev.) reversed) sum of z-scores of the percent of time using protection when cunnilingus agent, fellatio receptor, vaginal receptor; and (inversely weighted) frequency of vaginal reception, and cunnilingus agency.
- AARI Anal Agency (inserting partner) Risk Index** (alpha = .64): factor weighted sum of z-scores of the frequency, frequency of using protection, and percent of time using protection during anal sex agency.
- ARRI Anal Receptivity (person receiving penis) Risk Index** (alpha = .62): factor-weighted sum of z-scores of the frequency, frequency of using protection, and percent of time using protection during anal sex receptivity.

Multi-risk Behaviors

- SPRI Sexual Person Risk Index** (alpha = .76): sum of number of sexual partners, male sexual partners, and injecting-drug-using sexual partners.
- DISI Drug Impaired Sex Index** (alpha = .75): sum of z-scores for the frequency of having sex while also using alcohol, crack, other forms of cocaine, heroin, and/or speedballs.
- PSRI Purchasing Sex Risk Index** (alpha = .83) sum of dichotomous measures of whether the person had given money, any drugs, and/or crack to get sex during the past 30 days.
- TSRI Trading Sex Risk Index** (alpha = .86): sum of z-scores of dichotomous measures of whether the person had given sex to get money, any drugs, and/or crack during the past 30 days.
- SRRI Sex Risk Reduction Index** (alpha = .67): reversed sum of z-scores of (rev.) dichotomized measures of whether the individual reported attempting to reduce the number of sexual partners, use condoms/latex protection more often, and/or change sexual practices during the past 30 days.
-

Exhibit A. Further Detail on Factor Loadings

To do the cluster analysis, we further collapsed the 20 conceptual measures into four factors labeled: primary needle user pattern dimension (PNUPD), primary crack user pattern dimension (PCUPD), male alcohol and sexual pattern dimension (MASPD), and female drug and sexual pattern dimension (FDSPD). Equations 1 to 4 show their respective factor loadings (recall that NCI, NRRI, SRRI, MSPPI, and FSPPI have already been reversed):

$$(1) \quad \text{PNUPD} = .70(\text{OCFI}) + .57(\text{HFI}) + .73(\text{SFI}) + .89(\text{NFI}) + .51(\text{NSR}) - .58(\text{NCI})$$

$$(2) \quad \text{PCUPD} = .50(\text{CRFI}) + .61(\text{NCI}) + .82(\text{NRRI}) + .49(\text{SRRI})$$

$$(3) \quad \text{MASPD} = .32(\text{AFI}) + .53(\text{PSRI}) + .81(\text{MSPPI}) + .72(\text{MSPFI}) + .41(\text{AARI})$$

$$(4) \quad \text{FDSPD} = .86(\text{SPRI}) + .68(\text{DISI}) + .51(\text{TSRI}) + .89(\text{FSPFI}) + .57(\text{FSPPI}) + .27(\text{ARRI})$$

Exhibit B. Further Detail on Classifying Future Cases

To conduct the validations on other data we created a decision rule for classifying each case into its expected risk group. We did this in two ways: one, by assuming we had all of the RBA data available in the NIDA cooperative agreement and, secondly, by finding a subset of items that could be used in future studies. To create the full RBA decision rule, we first compared tukey box plots of the individual risk group by the a) 20 conceptual scales, b) four risk dimensional measures discussed in Exhibit A, c) geometric distance scores of the individual from the centroid of each of the eight clusters (in the four dimensions), and d) standardized (individual distance/mean distance) distance scores. We used the above plots to set cutoffs that would best approximate the most likely group an individual would be in, and then compared the result with actual classification. We compared this with the cluster results and then developed a second set of rules for reclassifying people who were likely to have been initially misclassified. This two-step decision rule could correctly classify 85% or more in every group, 95% or more in six of the eight groups and 100% in the three highest risk groups.

Fifth, we also wanted to see if we could predict which risk group people belonged to with only a fraction of the questions (over 200) and time (20-40 minutes) used in the RBA. To do this we selected individual questions from each of the 20 conceptual scales that had the highest item-total correlation; in one case we had to take two variables. From one scale we selected two items because it loaded on two different factors. Each of these items were simple and face valid questions about the past 30 days and, by the four factors, included:

- **Primary needle user pattern dimension:** days of cocaine injecting, days of heroin injecting, days of speedball injecting, times injected, times using “used” works, times reusing own works
- **Primary crack user pattern dimension:** days of crack use, number of new works used, any cleaning of needles with bleach, less (or less risky) sexual partners/practices,
- **Male alcohol and sex pattern dimensions:** days of alcohol use, given drugs for sex, vaginal sex agency frequency, vaginal sex agency protection ratio, anal agency frequency,
- **Female drug and sex pattern dimension:** number of different sexual partners, times used crack with sex, given sex to get drugs, vaginal sex reception frequency, vaginal reception protection ratio, and anal sex reception frequency.

We then did a discriminant analysis of these 21 items predicting the HIV risk groups used in this paper and were able to correctly classify 79.2 % (Kappa= .734). This is as good as most psychiatric diagnostic tests and represents a potentially cost-effective way of studying these risk groups further even in studies that do not use an RBA (Kraemer, 1992). A table of the variables and Fischer linear discriminant functions is available from the first author.

Table 2 Percentage of Variance Explained at Baseline and Follow-up by Alternative Models for Predicting Risk

Criterion Variables	Individual Risk Group (Initial) ^a				
	Site ^a	Gender	Target Population ^b	Current Sexual Pattern ^c	Risk Group ^d
Risk Behavior Assessment (RBA)^f					
Primary Needle User Pattern Dimension	19.9†	0.3ψ	41.0†	3.3†	82.3†
Primary Crack User Pattern Dimension	20.4†	1.3†	53.4†	1.9†	61.1†
Male Alcohol & Sex Pattern Dimension	2.6†	13.9†	1.0†	28.2†	65.8†
Female Drug & Sex Pattern Dimension	1.4†	15.1†	0.4ψ	27.6†	55.9†
Joint Distribution (1-Lamda)	46.5†	29.4†	64.2†	50.3†	99.6†
Risk Behavior Follow-up Assessment (RBFA)^g					
Primary Needle User Pattern Dimension	10.7†	0.1 ^{nsd}	21.2†	0.4 ^{nsd}	31.0†
Primary Crack User Pattern Dimension	23.7†	1.0†	37.6†	2.1†	36.4†
Male Alcohol & Sex Pattern Dimension	2.7†	9.0†	0.9ψ	12.1†	12.8†
Female Drug & Sex Pattern Dimension	1.5†	16.1†	0.2 ^{nsd}	20.4†	19.5†
Joint Distribution (1-Lamda)	31.3†	25.7†	42.7†	32.6†	62.8†
Degrees of Freedom Required by the Model	18	1	2	5	7

nsd no significant difference, ψp < .001, †p < .0001

^aAnchorage, Columbus-Dayton, Denver, Detroit, Flagstaff, Hartford, Houston, Lexington, Long Beach, Miami, New Orleans, New York, Philadelphia, Portland, Puerto Rico, San Francisco, St. Louis, Tucson, Washington, DC.

^bInjection Drug User, Crack User, or Both.

^cCelibate, Male Heterosexual, Male Bisexual, Male Homosexual, Female Heterosexual, Female Bisexual, Female Lesbian.

^dPrimary Crack Users (PCU), Crack/Cocaine and Sexual Risk (CSR), High Poly Risk Type 1 (HPRT1), Poly Drug and Sexual Risk (PDSR), Primary Needle Users (PNU), High Poly Risk Type 2 (HPRT2), High Frequency Needle Users (HFNU), High Risk Needle Users (HRNU).

^eExpected Risk groups from note above plus the RBA value of the four dimension variables used to predict their value at RBFA.

^fObserved at Month=0, with n=4,445.

^gObserved at Month=6, with n=1,799.

Source: NIDA AIDS Cooperative Agreement Q1 Methodology Study Data Set (25% of 12/94 Data Set).

Figure 8. Range of Effect Sizes for 21 Questions by HIV Risk Group

